SIEMENS

SIMATIC FS600 Laser Scanner
3RG7834 / 3SF7834

Laser Scanner for Personnel Protection and Measurement Tasks

Instruction Manual

CE

Warning

The SIMATIC FS600 Laser Scanners are designed to protect operators working at or in the vicinity of dangerous machinery. They can only fulfill their protective requirements if they are installed to a suitable machine. It is therefore vital that you fully understand the information provided in this instruction manual and in all documents mentioned herein before any installation attempt. For any question please refer to your local SIEMENS dealer.

Important

This instruction manual must accompany the product throughout its working life. Those persons responsible for the product must ensure that all persons involved in the installation, commissioning, operation, maintenance and servicing on the product have access to all the information supplied by the manufacturers of the machine and its safety system.

Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ **DANGER**
indicates that death or severe personal injury will result if proper precautions are not taken.

⚠ **WARNING**
indicates that death or severe personal injury may result if proper precautions are not taken.

⚠ **CAUTION**
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by qualified personnel. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

> ⚠ **WARNING**
>
> This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

About this Instruction Manual

This instruction manual contains information on the proper use and effective application of the SIMATIC FS600 Laser Scanner.

⚠ **WARNING**
All the information contained herein, in particular the safety notes, need to be carefully observed.

Notes regarding safety and warnings are marked by this symbol ⚠.

Notes regarding important pieces of information are marked by the symbol .

References to the safety of laser devices are identified with the symbol .

This instruction manual must be stored carefully. It must be available for the entire operating time.

SIEMENS AG is not liable for damages caused by improper use. Knowledge of this instruction manual is an element of proper use.

	⚠ **Warning**
	Dangerous electric voltage! Electric voltage can cause electric shock and burns. Before commencement of work you therefore need to turn the system/device power off.

Important note

Safe device operation can only be guaranteed when certified components are used! The products described herein were developed to take over safety-related functions as part of a turn key system or machine. A complete safety-related system is usually equipped with sensors, evaluation units, status controls and incorporates concepts for safe switch-off procedures. It is the responsibility of the manufacturer of a system or a machine to ensure its correct overall operation. SIEMENS AG, its local offices and associated companies (hereafter referred to as “SIEMENS”) cannot guarantee for all features of a turn key system or a machine that was not designed by SIEMENS.
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1 About this document

1.1 Other applicable documents

The information on the Safety Sensor is distributed over several documents to make working with the documents easier. You will find the documents and programs for the Safety Sensor in the following table:

Purpose and target group of the document	Document/software title	Source
Basic information for all users of the machine*; on paper so that the information is always at hand	Application information	Art. no. 607160** Included with the product delivery as print and on CD-ROM
Software for users of the machine* for Safety Sensor diagnostics if a fault occurs and for machine design engineers* for configuring the Safety Sensor	LS4soft	Included with the product delivery on CD-ROM**
Notes for the machine design engineer*	Instruction Manual (this document)	Art. no. 607164** Included with the product delivery on CD-ROM
Notes for the machine design engineer* for configuring the Safety Sensor (Software LS4soft instructions)	Operator's Manual	Art. no. 607163** Included with the product delivery on CD-ROM
Additional information on SIMATIC FS600 AS-i Laserscanner 3SF7834	Additional information for Instruction Manual	Art. no. 607061** Included with the product delivery on CD-ROM
Additional information on SIMATIC FS600 PROFIBUS Laserscanner 3SF7834	Additional information for Instruction Manual	Art. no. 607062** Included with the product delivery on CD-ROM

* identifies the product that the Safety Sensor is installed in.

** You download the current version of the software and all documents as PDF on the Internet at: http://www.siemens.com/automation

1.2 Means of illustration used

Table 1.1: Warning symbols and signal words

	Symbol for danger
NOTICE	Signal word for damage to property Indicates dangers that could damage the Safety Sensor if the measures for preventing danger are not implemented.
CAUTION	Signal word for minor injuries Indicates dangers that could slightly injure you if the measures for preventing danger are not implemented.
WARNING	Signal word for serious injuries Indicates dangers that could seriously or fatally injure you if the measures for preventing danger are not implemented.
DANGER	Signal word for danger to life Indicates dangers that could seriously or fatally injure you if the measures for preventing danger are not implemented.

Table 1.2: Further symbols

	Symbol for tips Texts with this symbol provide you with further information on handling the Safety Sensor.
	Symbol for action steps Texts with this symbol instruct you on how to perform actions.

2 Safety

⚠ WARNING

If the Safety Sensor is not professionally selected and put into use, serious accidents may occur.

- Carefully follow all notices and information on the Safety Sensor.
- Ensure that all other people also know about and observe the applicable notices.

The documents are part of the product. Non-observance presents a high risk to personal health and life.

- Observe the documents on the CD ROM included with the product.

  Alternatively you can also download the current documents on the Internet.

  Internet: http://www.siemens.com/automation

For an overview of other applicable documents See chapter, "Other applicable documents", page 11.

- Read and observe the documents that apply for your activities in full before you work with the Safety Sensor.

Print out the relevant text parts to make reading and handling the documents easier.

2.1 Proper use according to intended purpose

The Safety Sensor is used to protect people in danger zones or at points of operation on machines and to protect objects and machine parts against the dangers of collision.

The Safety Sensor may only be used after it has been put into operation in accordance with the applicable instructions, relevant rules and regulations on occupational health and safety at work and the recognized safety-related rules and regulations have been placed on the machine by an **appropriately qualified person**.

The Safety Sensor must be integrated into the machine's electrical control system in such a way that an activation of the safety function safely stops or interrupts the dangerous process before a person can be endangered.

If the machine does not allow the dangerous movement to be stopped at all times, you may not install the Safety Sensor. Do not use the Safety Sensor, for example, together with a press with form-locking coupling.

2.2 Appropriately qualified person

Appropriately qualified is a person that,

- has acquired adequate knowledge and skills with regard to operating the machine, the configuration and diagnostics software and testing the Safety Sensor through training and practical experience and has proven their capabilities in practice,
- and is so well versed in the applicable rules and regulations on occupational health and safety at work and the recognized safety-related rules and regulations that he/she can evaluate the safety of the machine,
- and has been instructed in the machine's operation and safety rules and regulations,
- and has read and understood the respective applicable instructions for the Safety Sensor and the machine's operating instructions,
- and has been charged by the respective person responsible for the machine's safety with the testing of the Safety Sensor.

2.3 Responsibility for safety

The responsibility for the safety-assured use of the Safety Sensor and compliance with the regulations and directives that apply in the country of use lies with the machine's manufacturer and company operating the machine.

The machine manufacturer is responsible for:

- The safe design and construction of the machine.
- The safe implementation of the Safety Sensor.
- The provision of all relevant information to the operator.
- Compliance with all regulations and directives for safely putting the machine into operation.

The machine company operating the machine is responsible for:

- Instructing the operating staff.
- Maintaining the safe operation of the machine.
- Compliance with all occupational health and safety at work regulations and directives.

Passwords

Improperly set parameters on the Safety Sensor can cause serious accidents. The configuration of the Safety Sensor is therefore protected by passwords.

- Ensure that the passwords are kept locked away by the security officer.
- The people responsible for the machine's safety must ensure that the appropriately qualified person can properly perform the tests and work on the machine and the Safety Sensor in accordance with their intended use.

2.4 Laser

The Safety Sensor corresponds with laser class 1. Additional activities for shielding the laser beams are not required (safe for eyes).

- Observe the applicable legal and local regulations for operating laser equipment.

2.5 Handling the Safety Sensor

- Observe the permissible environmental conditions for storage and operation.

Front screen and scatter screens

The Safety Sensor's front screen and scatter screens must be clean, free of damage and properly installed.

- Avoid touching the front screen and scatter screens.
- Clean dirty screens immediately (according to these instructions).
- Have damaged screens replaced immediately (according to these instructions).

Screwed-on cables

Improper handling can damage the Safety Sensor and result in safety-relevant signals not being sent. The Safety Sensor's IP type of protection is only guaranteed with screwed-on plug cover caps.

- Only operate, transport and store the Safety Sensor with screwed-on control cable (X1) and PC cable (X2) or dummy plug (X2).

2.6 Usage limits

Only on closed rooms

The Safety Sensor is **not suitable for use outdoors or under conditions with significant temperature fluctuations**. Humidity, condensation and other weather influences can impair the safety function.

- Only use the Safety Sensor in closed rooms.
- Observe all technical data and ambient conditions.

Industrial use only

The Safety Sensor is **not suitable for residential areas**, because it can cause radio interferences.

↳ Only use the Safety Sensor in industrial environments.

Not on vehicles with combustion engines

The Safety Sensor is **not suitable for use on vehicles with combustion engines**, because alternators or ignition systems can cause EMC disturbances.

↳ Only use the Safety Sensor on vehicles without a combustion engine.

No changes on the Safety Sensor

The construction of the Safety Sensor **may not be changed**, because the protective function can no longer be guaranteed if the Safety Sensor is changed. Where changes are made to the Safety Sensor, all guarantee claims against the manufacturer of the Safety Sensor shall no longer apply.

Service life T_M in accordance with DIN ISO 13849

The Safety Sensor's details, PL and PFH_d, refer to the T_M service life of 20 years.

Repairs or replacement of wear and tear parts do **not** extend the service life.

Protective function limits

The Safety Sensor does not protect against:

- Projected (thrown out) parts
- Splashing/spraying liquids
- Gases and vapors
- Radiation

2.7 Guarantee the availability of the Safety Sensor

Vapors, smoke, dust, particles

Vapors, smoke, dust and all particles visible in the air can cause the machine to switch off unintentionally. This can mislead the user into bypassing the safety devices.

↳ Do not use the Safety Sensor in environments in which heavy vapors, smoke, dust or other visible particles occur at the beam level.

No stray light

Light sources can impair availability. Interfering light sources are:

- Infrared light
- Fluorescent light
- Strobe light

↳ Ensure that there are no interfering light sources at beam level.

↳ Prevent reflective surfaces at beam level.

↳ Where applicable, take additional protective field distances into account.

↳ Implement all additional measures to ensure that any special use of any effected beam types does not impair the Safety Sensor's operation.

No obstructions in the protective field

↳ Do not bring any additional window materials into the area monitored by the Safety Sensor.

2.8 Providing the company operating the machine with information

The machine manufacturer must inform the machine company operating the machine in detail and comprehensibly about all activities that are required for the safety-assured operation of the machine with the Safety Sensor. This also includes the forwarding of information from these instructions that the operator requires.

The type and content of the information may not, however, result in any questionable safety-related actions by the user.

Where required, safety key, special tools and passwords should be maintained under the control of one or more responsible or authorized people.

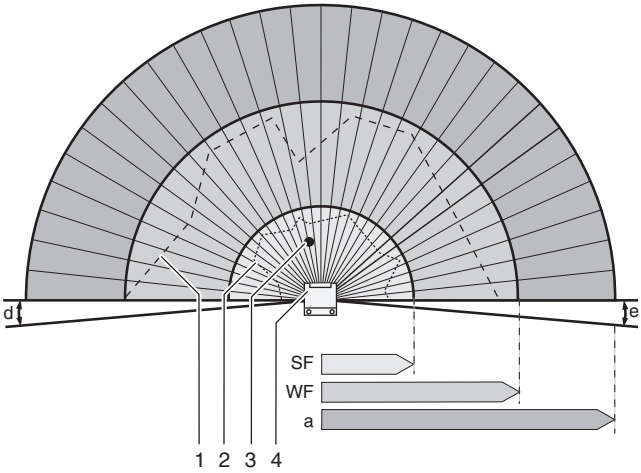
3 Device description

The SIMATIC FS600 laser scanner 3RG7834 / 3SF7834 Safety Sensor is an optical, two-dimensional measuring Safety Laser Scanner.

The Safety Sensor transmits periodic light pulses via a rotating deflection unit. The light pulses are reflected by obstructions, e.g. people, and received by the Safety Sensor again and analyzed. The Safety Sensor calculates the precise position of the obstruction from the light travel time and the angle of the deflection unit at that time. If the obstruction is within a predefined area, the protective field, the Safety Sensor performs a safety-related switching function. It switches the safety-related switching outputs off.

Only when the protective field is free again does the Safety Sensor reset the safety-related switching function, either automatically or following confirmation, depending on the operating mode.

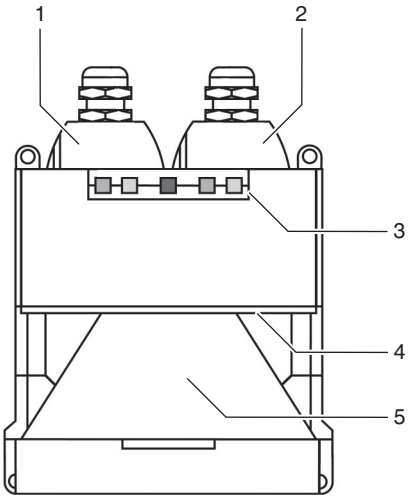
The Safety Sensor can even detect people when they are wearing very dark clothes, which have a very weak diffuse reflectance.



Pic. 3.1: Safety Sensor detection ranges

Pos.	Name	Comment
1	Configured warning field	Example
2	Configured protective field	Example
3	Object (person) in the protective field	Example
4	Safety Sensor	
a	Maximum measurement value logging	50 m
d	Configurable protective and warning field extension	-5°
e	Configurable protective and warning field extension	+5°
PF	Maximum protective field	
WF	Maximum warning field	

3.1 Device overview



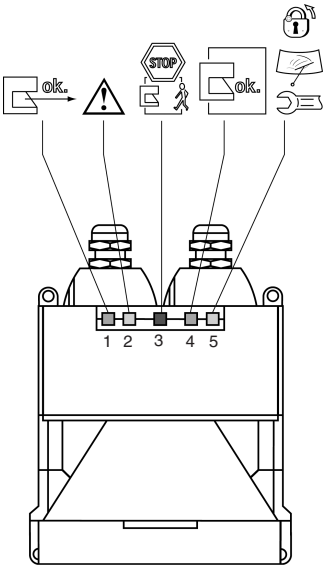
Pic. 3.2: Safety Sensor overview

1 X1 interface for controlling the machine, with protective cap
2 X2 interfaces for PC/laptop, with protective cap
3 Status display
4 Scatter screens
5 Front screen

3.2 Display elements

Status display

Five LEDs on the front show the Safety Sensor's status



Pic. 3.3: Status displays

Table 3.1: What the LEDs mean

LED			Meaning
ok.	1, green	Lights	Sensor function is active; the active protective field is free.
		Flashes with 2 Hz	Fault on the field pair control inputs.
		Flashes with 4 Hz	MotionMonitoring has detected a fault.
⚠	2, yellow	Lights	Active warning field is seized.
		Flashes with 2 Hz	Front screen is dirty.
		Flashes with 4 Hz	ConfigPlug configuration is not compatible with the Safety Sensor.

LED			Meaning
	3, red	Lights	Safety-related switching outputs (OSSD 1 and 2) are switched off.
	4, green	Lights	Safety-related switching outputs (OSSD 1 and 2) are switched on.
	5, yellow	Lights	Start/restart interlock is active.
		Flashes with 2 Hz	Front screen is dirty.
		Flashes with 4 Hz	Fault

3.3 Mounting system (option)

The mounting system makes it easier to install and align the Safety Sensor. The mounting system is available as an accessory.

3.4 ConfigPlug (option)

The ConfigPlug makes it easier to swap out the Safety Sensor. It saves the configuration when the PC is configured and automatically transfers it with the device swap-out to the replacement device. The ConfigPlug is available as an accessory.

4 Functions

The functions must be coordinated with the respective application.

You configure the functions with the help of the LS4soft configuration and diagnostics software.

4.1 Start/restart interlock

The *start/restart interlock* has two functions:

- Start interlock
- Restart interlock

Using start/restart interlock

- In addition to the Safety Sensor you must also install the start/restart button. The machine operator starts the machine with this start/restart button.
- Position the start/restart button outside the danger zone so that it cannot be activated from the protective fields and danger zones. The operator must be able to see all danger zones from this position.
- Identify the zone to be released at the start/restart button so that it's meaning is clear and easy to understand.
- Ensure that nobody is in the danger zone **before** pressing the start/restart button.

4.1.1 Start interlock

The *start interlock* function prevents the machine from starting automatically after switching on or after the power supply returns.

The machine only starts when you press the start/restart button.

4.1.2 Restart interlock

The *restart interlock* prevents the machine from starting automatically, as soon as the protective field is free again. The *restart interlock* function always includes the *start interlock* function.

The machine only starts again when you press the start/restart button.

4.2 Start test

The *start test* function compels the operator to interrupt the protective field once after the Safety Sensor start, e.g. with a test rod. Only then can the machine be started.

Using the start test

If you combine the *start test* with the *automatic restart* function, the start test serves as an automatic start/restart signal.

4.3 Automatic start/restart

The machine starts automatically as soon as the machine is switched on or the supply voltage returns and when the protective field is free again.

Using automatic start/restart

You can use the *automatic start/restart* function under the following conditions.

- The *automatic start/restart* function is taken over by a downstream safety-related component of the machine control system.
  or
- It is not possible to walk behind or go around the effective protective field.

↳ Allow for an optical and/or acoustic start warning.

4.3.1 Automatic start

The *automatic start* function starts the machine automatically as soon as the supply voltage is present.

4.3.2 Automatic restart

The *automatic restart* function starts the machine automatically as soon as the protective field is free again.

4.4 Dust suppression

The *dust suppression* function increases the availability of the Safety Sensor when small particles are in the air, e.g. material chips or insects.

Only deactivate the dust suppression function when, in addition to people, the Safety Sensor must also detect extremely fast and small objects in your application.

If you use the Safety Sensor for the mobile danger zone guarding of AGVs, you must select the speed range of your vehicle to optimize the dust suppression.

4.5 Field pair switchover

The Safety Sensor has four or eight field pairs. Switchover between the field pairs is possible at all times, provided the operating situation allows this.

During the switchover process the Safety Sensor monitors the field pair activated before the switchover until a new one has been clearly activated.

Use the field pair switchover when the danger zones vary depending on the activity of the machine or the operating status, e.g. automated guided vehicle systems (AGVs), to control the protective field switchover for straight and curved stretches.

If the rules for field pair switchover are not complied with, the Safety Sensor signals a fault and the machine stops.

Using field pair switchover

You can configure and switch over the field pairs according to the different requirements. The switchover is performed via the corresponding control inputs on the X1 interface.

The precepts for the switchover depend on the amount of the selected field pairs and their numbers. The activated field pair must correspond with the respective operating mode. The time of the switchover must correspond with the machine's risk assessment. You must take the braking distances, response times and machine stopping times, e.g. influenced by overlapping protective fields, into account.

If these rules are not complied with, the Safety Sensor goes to a fault status within 40 ms. The green LED 1 flashes with 2 Hz.

The following rules apply for switching over four field pairs:

- First the control unit must switch to a new field pair before it switches of the previous one.
- The switchover must be made within 1 sec. Both field pairs are monitored during the switchover time.
- All field pairs must **never** be deactivated during the switchover.
- The switchover process performed by the control system must agree with the Safety Sensor's configuration. This configuration is specified with the configuration and diagnostics software.

Table 4.1: Connection of control inputs FP1 to FP4 with activation of field pairs 1 to 4.

Field pair	Control input				Description
	FP1	FP2	FP3	FP4	
1	1	0	0	0	Field pair 1 is active
2	0	1	0	0	Field pair 2 is active
3	0	0	1	0	Field pair 3 is active
4	0	0	0	1	Field pair 4 is active

The following rules apply for switching over eight field pairs:

- The switchover must be made within 40 ms, i.e. after 40 ms an input connection must be valid and stable. The old field pair is monitored during the switchover time. The new field pair is monitored after max. 80 ms.
- The switchover process performed by the control system must agree with the Safety Sensor's configuration. This configuration is specified with the configuration and diagnostics software.

Table 4.2: Connection of control inputs FP1 to FP4 with activation of field pairs 1 to 8.

Field pair	Control input				Description
	FP1	FP2	FP3	FP4	
1	1	0	0	0	Field pair 1 is active
2	0	1	0	0	Field pair 2 is active
3	0	0	1	0	Field pair 3 is active
4	0	0	0	1	Field pair 4 is active
5	1	1	1	0	Field pair 5 is active
6	1	1	0	1	Field pair 6 is active
7	1	0	1	1	Field pair 7 is active
8	0	1	1	1	Field pair 8 is active

WARNING

Field pair switchover to field pair 8 deactivates the monitoring function

No field pair is no monitored; the safety outputs (OSSDs) remain constantly active.

- **Never** start the Safety Sensor with field pair 8.
- Only use field pair 8 when there is no danger for people present, e.g. with vehicles in creep and reverse, in the area of loading or park positions or during machine cycles with which there is no danger for the operating staff.

4.6 Reference contour monitoring

The *reference contour monitoring* function prevents unintentional dealignment and deliberate manipulation of the Safety Sensor. If a protective field contains a reference contour, the Safety Sensor not only monitors interruptions of the protective field – it also monitors the concurrence of the measured ambient contours with the set reference contour. If the measured values differ by more than the tolerance zone of the defined reference contour, the Safety Sensor switches off and the safety-related switching outputs (OSSDs) go to *off*.

4.7 MotionMonitoring

The *MotionMonitoring* function supports you with the configuration of the Safety Sensor for the mobile danger zone guarding application, and during the operation, monitors whether or not the control system has selected the correct, situation-appropriate protective field.

The Safety Sensor calculates the current speed from the measured values and compares this with the speed that is given in the speed matrix for the protective field.

- If the speed is higher than the speed given for the protective field, the Safety Sensor corrects by one protective field upwards. If a second correction is required with an even faster speed, the Safety Sensor stops the transfer trolley.
- If the maximum speed is exceeded, the Safety Sensor stops the transfer trolley.

Pedestrian traffic on the driveway is possible because it is included in the calculations by the Safety Sensor.

Two further functions are integrated into the *MotionMonitoring* function, which are assigned to the two field pairs, 7 and 8:

- Further travel block – field pair 7
- Creep and reverse – field pair 8

Further travel block

The *further travel block* function prevents the transfer trolley from moving as long as field pair 7 is active. The Safety Sensor switches the safety-related switching outputs in field pair 7 off. The transfer trolley can start to move again when the control switches to another protective field.

Creep and reverse and reverse

A Safety Sensor is mounted in both directions when a transfer trolley travels forwards and backwards. The *creep and reverse* function deactivates the Safety Sensor that is positioned opposing the current travel direction. This Safety Sensor only monitors speed and travel direction. The maximum speed with a creep speed is 100 mm/s. If the transfer trolley moves faster than 100 mm/s, the Safety Sensor switches the safety-related switching outputs off and stops the transfer trolley.

Using MotionMonitoring

Requirements for using the *MotionMonitoring* function:

- Transfer trolley (AGV) with linear movement
- Driveway length max. 50 m
- Driveway restricted at both ends by a wall or boundary

↳ Enter the speed levels of the AGV and the braking distance with maximum speed in the speed matrix with the configuration.

The software interpolates the missing braking distances and automatically defines the protective and warning fields.

The configuration and diagnostics software shows the calculated measured values and a status display of the speed monitoring during the first start-up.

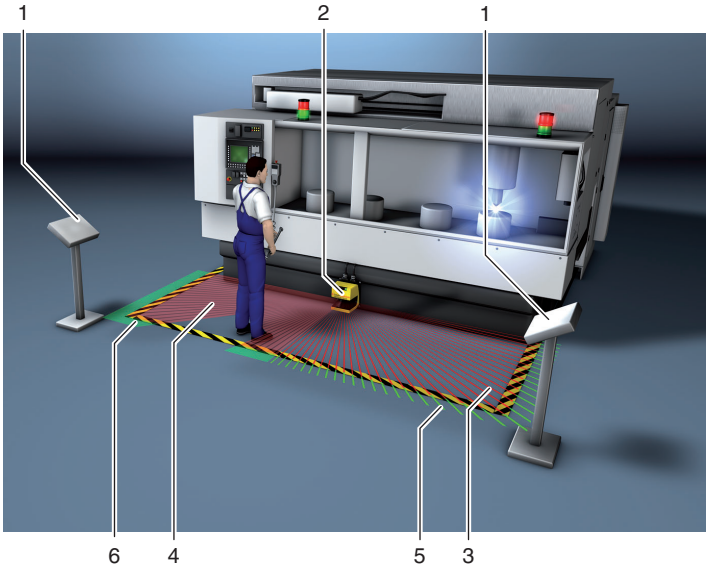
5 Applications

The following chapters essentially describe the Safety Sensor's usage possibilities. To safely configure and mount the Safety Sensor for the respective application, see Chapter 6.

5.1 Stationary danger zone guarding

Stationary danger zone guarding enables a very spacious protection of people on machines that are to remain as accessible as much as possible. The Safety Sensor is applied as a stop-activating and presence-detecting protective device. The Safety Sensor's protective field is set up horizontally in front of the machine or system's point of operation.

You can also use the stationary danger zone guarding if you do have to guard areas under the machine or at the rear that are not visible.

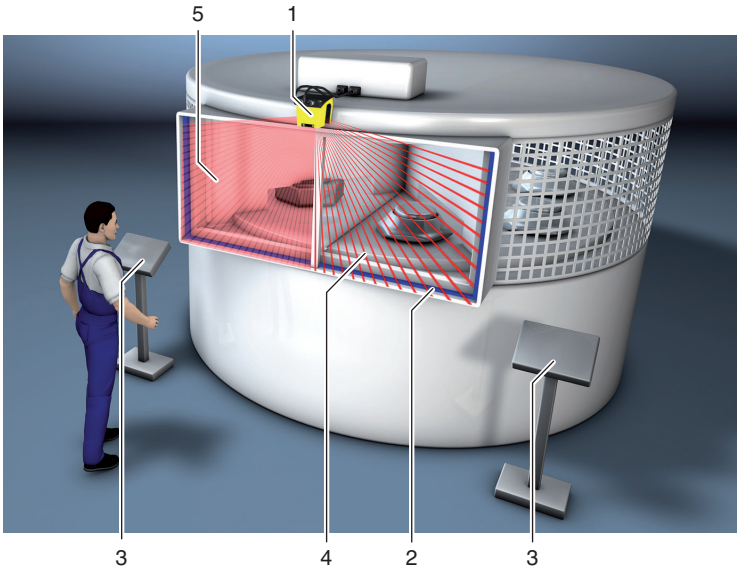


Pic. 5.1: Stationary danger zone guarding with two alternating work areas

1 EMERGENCY STOP control device and start/restart button
2 Safety Sensor
3 Protective field 2, activated
4 Protective field 1, deactivated
5 Warning field 2, activated
6 Warning field 1, deactivated

5.2 Stationary point of operation guarding

Hand and arm protection are always required when people must work at the point of operation. The Safety Sensor is applied as a stop-activating and presence-detecting protective device. The Safety Sensor's protective field is set up vertically in front of the machine or system's point of operation. With small protective field dimensions the Safety Sensor provides the correspondingly required high resolution level. A sufficient safety distance to the point of operation ensures the finger protection.

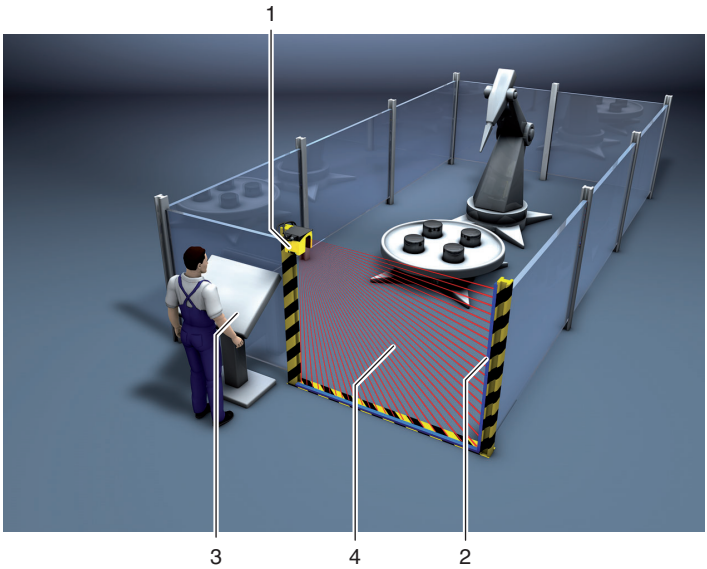


Pic. 5.2: Stationary point of operation guarding with protective field switchover

1 Safety Sensor
2 Reference contours of both protective fields
3 EMERGENCY STOP control device and start/restart button
4 Protective field 1, activated
5 Protective field 2, deactivated

5.3 Stationary access guarding

Stationary access guarding protects people that step into a danger zone. The vertically aligned protective field of the Safety Sensor detects the passage of a person. A side post and the floor serve as reference contour for monitoring the position of the protective field. In contrast to danger zone guarding, the Safety Sensor no longer registers a person in the danger zone after the passage. This is why the *start/restart interlock* function is vital for access guarding.

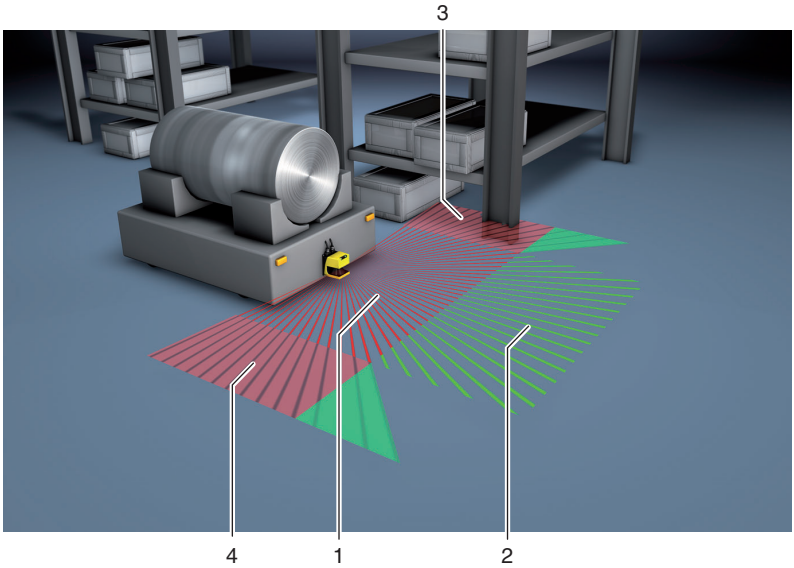


Pic. 5.3: Stationary access guarding

1 Safety Sensor
2 Reference contour of the protective field
3 EMERGENCY STOP control device and start/restart button
4 Protective field

5.4 Mobile danger zone guarding

Mobile danger zone guarding protects people that are located in the driveway of an automated guided vehicle. The distance between the protective field front edge and the vehicle front must be greater than the stopping distance of the vehicle with selected speed and maximum load. A safe control system selects speed-dependent protective fields and can activate side horizontal protective fields for curved stretches.

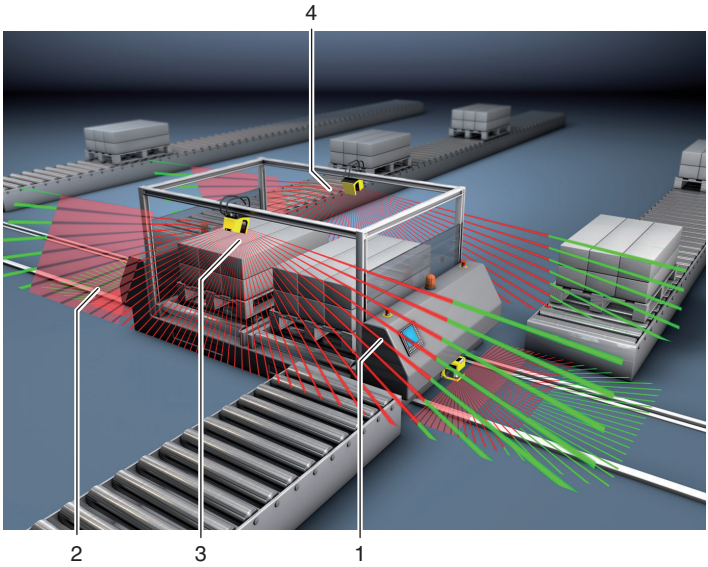


Pic. 5.4: Mobile danger zone guarding

1 Protective field 1 for forward travel, activated
2 Warning field 1 for forward travel, activated
3 Protective field 2 for curved stretch, left, deactivated
4 Protective field 3 for curved stretch, right, deactivated

5.5 Mobile side guarding

Mobile side guarding protects people and objects that are located on the vehicles path. This application is used when very low arranged conveyor lanes do not permit an unobstructed passage of horizontal, lateral overlaying protective fields. The Safety Sensors are positioned laterally and the protective fields are arranged vertically, at a slight tilt. The position of the front edges of the side protective fields is oriented here on the position of the front edge of the horizontal protective field.



Pic. 5.5: Mobile side guarding on transfer trolleys

1 Protective field and warning field pair for forward travel, activated
2 Protective field and warning field pair for reverse travel, deactivated
3 Protective field and warning field pair for side guarding, right, activated
4 Protective field and warning field pair for side guarding, left, activated

6 Installation

6.1 Basic infos

The Safety Sensor's protective function is only guaranteed when the device arrangement, configuration, protective field dimensioning and installation are coordinated with the respective application.

The installation work must only be performed by an appropriately qualified person in compliance with the applicable standards and these instructions. The installation must be thoroughly inspected on completion.

- You must observe and comply with the respective relevant machine-specific standards and regulations.

Basic procedure

- Select the appropriate device type for the application.

Application	Device type SIMATIC	Resolution	Configuration and installation notes
Stationary danger zone guarding	FS620 FS660	50 - 70 mm	Chapter 6.3
Stationary point of operation guarding	FS660	30 - 40 mm	Chapter 6.4
Stationary access guarding	FS660	150 mm	Chapter 6.5
Mobile danger zone guarding on AGVs	FS620 FS670	70 mm	Chapter 6.6
Mobile side guarding on AGVs	FS620	150 mm	Chapter 6.7

- Determine the installation point.
- Determine whether you are going to install the Safety Sensor with or without the mounting system.
- Determine the size of the protective field on the basis of the point of installation, the calculated safety distances and additional distances.
- Determine the start/restart operating mode required for the application.
- If you are using start/restart interlock, determine the position for the start/restart button.

- Determine the conditions for the field pair switchover, if required.
- Configure the Safety Sensor with the configuration and diagnostics software.

  Many safety-relevant parameters are preset in the configuration and diagnostics software. Use these preset values where possible.
- Create a record document for the device configuration and protective field dimensioning. The document must be signed by the person responsible for the configuration.

  Include this document with the machine documentation.
- Install protective enclosures or safety bars if the Safety Sensor is in an exposed position.
- If there is a risk that the Safety Sensor will be used as a climbing aid, install a suitable physical cover over the Safety Sensor.

  Ensure that machine parts, protective grids or covers do not impair the Safety Sensor's field of vision.

6.2 Basic infos on the protective field dimensioning

- Dimension the protective field big enough that the Safety Sensor's switch-off signal can stop the dangerous movement in good time.

  If several protective fields are selected with field switchover, this condition applies for all protective fields.

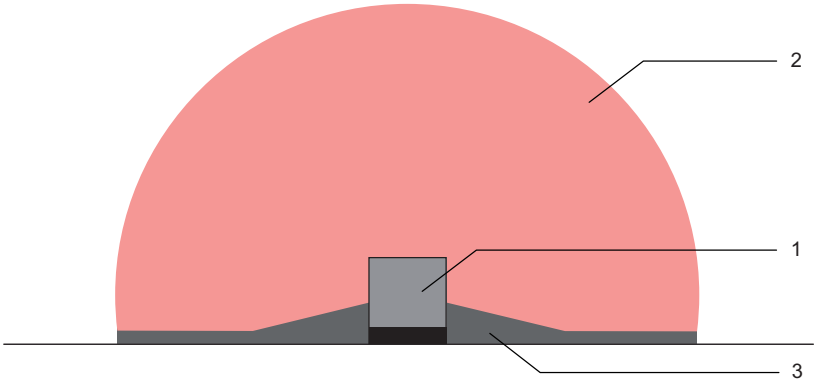
  Protective fields with a radius of less than 200 mm (Safety Sensor close range) are not permitted and are therefore preset as minimum contour.
- If you cannot sufficiently dimension a protective field, use additional protective measures, e.g. protective grids.
- Ensure that the protective field cannot be walked behind in the direction of the danger zone.
- Observe all delay times, e.g. Safety Sensor response times, control element response times, braking times or machine or AGV stopping times.
- Take changed delay times, which, for example, can be caused by reducing the braking force, into account.
- Observe shadowing effects, e.g. surfaces and areas behind static objects. People in the shadows of these objects will not be detected by the Safety Sensor.
- Observe the lateral tolerance when dimensioning the protective fields (see chapter, "Technical data", page 60).

- Do not use cone-shaped protective field contours, as these do not guarantee any protective effect.
- Take the additional distances required for the application into account.

6.2.1 Handling unmonitored areas

There is an area behind the Safety Sensor that the Safety Sensor does not monitor. Unmonitored areas can also materialize, e.g. if you install a Safety Sensor on a rounded off vehicle front.

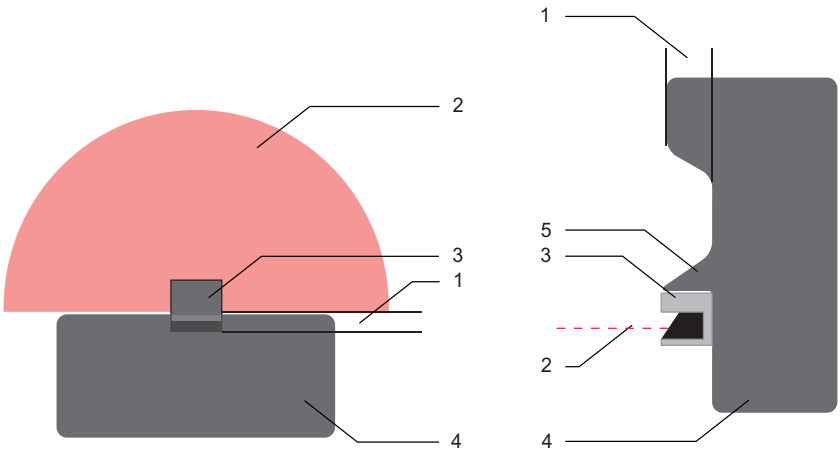
It must not be possible to walk behind unmonitored areas.



Pic. 6.1: Protective field shape – unmonitored areas

1 Safety Sensor
2 Protective field
3 Unmonitored area

- Prevent access to an unmonitored area with screens.
- Prevent walking behind by countersinking the Safety Sensor into the machine contour.



Pic. 6.2: Rear area protection by countersinking into the machine contour

1 Countersinking into the machine contour
2 Protective field
3 Safety Sensor
4 Machine
5 Physical cover

- Use a physical cover set at an angle over the Safety Sensor if you expect that the Safety Sensor will be used as a climbing aid or standing surface.

6.2.2 Protective field setup with adjacent Safety Sensors

The Safety Sensor has been developed in a way that prevents several Safety Sensors from interfering with one another as much as possible. Several adjacent Safety Sensors can, however, cause the response time to increase if the fields overlap.

WARNING

The response time extends with reciprocal influencing of adjacent Safety Sensors.

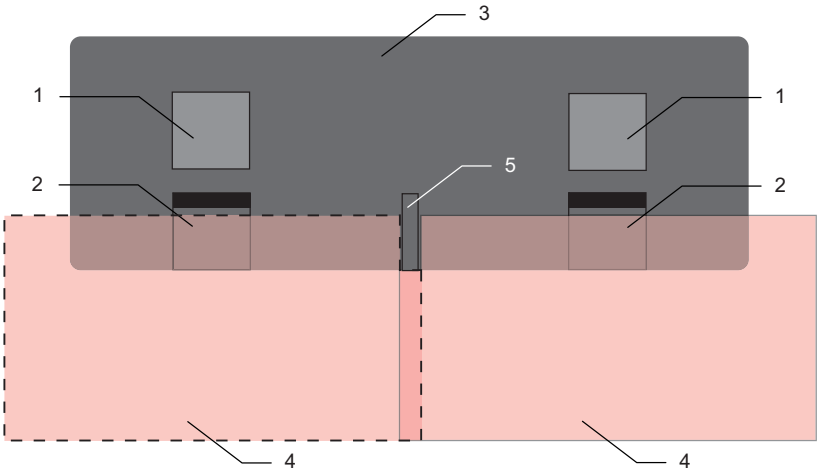
- If you do not plan for any measures against reciprocal influencing, take a response time extension of 40 ms into account with the safety distance calculation.

- Plan for shielding with stationary applications.

The shielding must be at least as high as the Safety Sensor's front screen and flush with the front housing edge.

If you plan for a shielding that is still within the countersinking in the machine contour, the resolution of the protective fields must not be impaired at any accessible points.

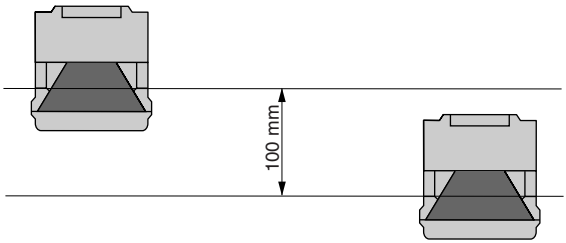
You require the reciprocal shielding with both horizontal and vertical alignment of the protective fields.



Pic. 6.3: Shielding prevents reciprocal influencing of Safety Sensors set up beside one another.

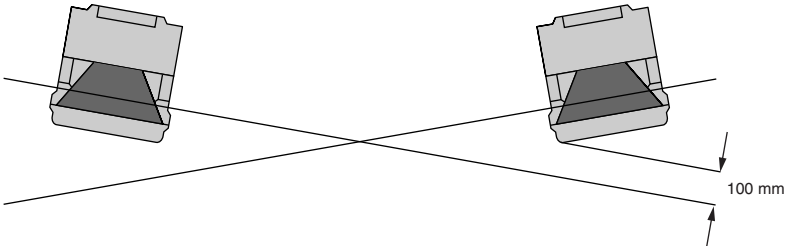
1 Point of operation
2 Safety Sensor
3 Machine with countersinking for Sensor installation
4 Protective fields
5 Shielding

↳ Install the Safety Sensors off-set on the height.

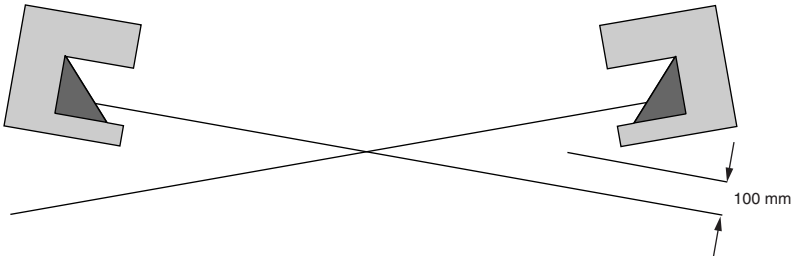


Pic. 6.4: Height offset installation, parallel alignment

↳ Install the Safety Sensors with crossed alignment.

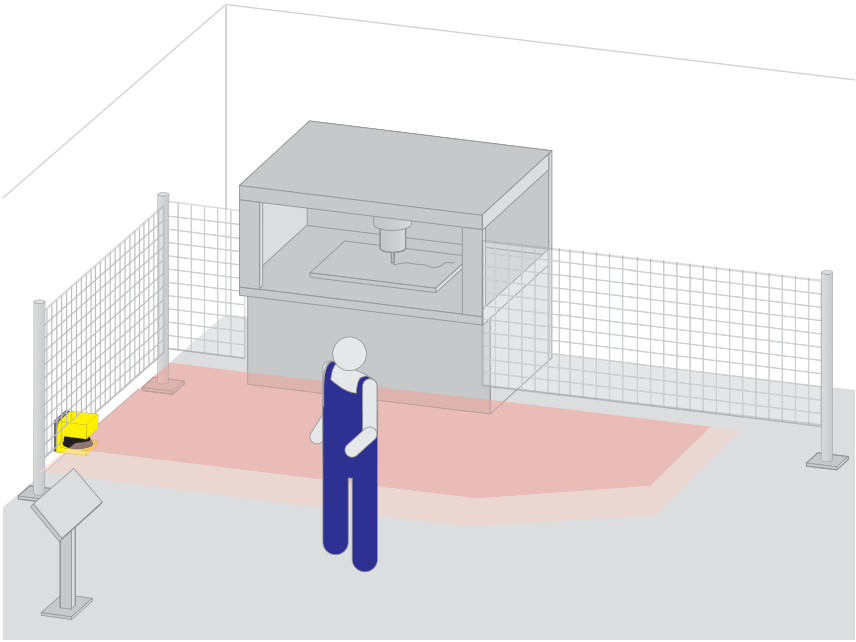


Pic. 6.5: Installation beside one another, without height offset, crossed alignment



Pic. 6.6: Opposing installation, without height offset, crossed alignment

6.3 Stationary danger zone guarding



Pic. 6.7: Safety Sensor activates the stop and, with protective field with rear area protection, performs a presence-detecting function.

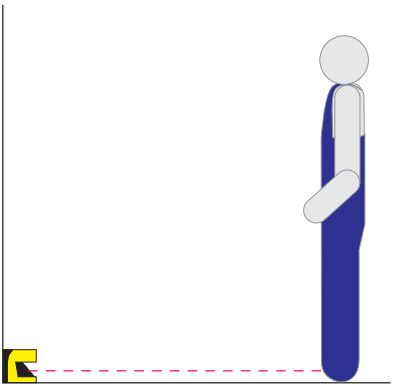
Procedure

- Determine the height of the beam level.
- Calculate the necessary safety distance and determine the required additional distances for your application.
- Define the protective field limits and the warning field limits if required.
- Configure the protective field so that the safety-related switching outputs are switched off from every accessible point with sufficient minimum distance "D".
- Mark the protective field limits on the floor.

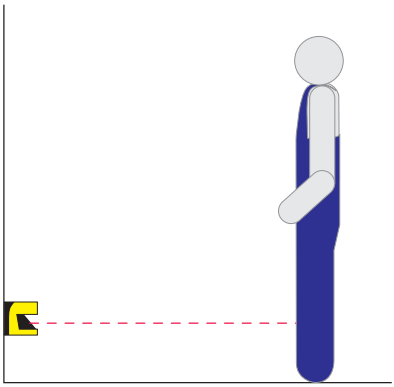
  You can easily test the Safety Sensor along this marking.

6.3.1 Beam level height

The minimum height of the beam level depends on the Safety Sensor resolution. To detect a human leg a resolution of 50 mm is required at ankle height, and 70 mm at calf height (300 mm off the floor).



Pic. 6.8: Beam level close to the floor – 50 mm resolution is required



Pic. 6.9: Beam level at 300 mm – 70 mm resolution is required

$$H_{MIN} = 15 \cdot (d - 50)$$

H_{MIN} Lowest permissible beam height from the standing surface level in mm

d Safety Sensor resolution in mm

H_{MAX} = 1000 mm

6.3.2 Safety distance "S"

The B standard, ISO 13855/EN999 specifies the general formula for the safety distance as follows:

$$S = K \cdot (T_1 + T_2 + T_3) + C$$

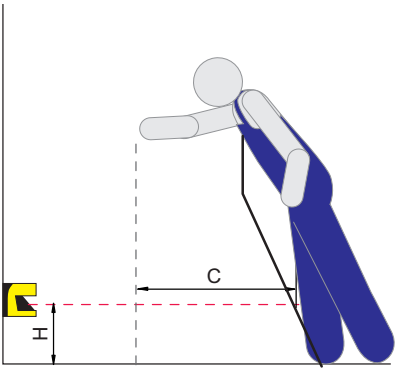
S	Safety distance in mm
K	Approach speed in mm/s For parallel approach on a horizontally arranged protective field: 1600 mm/s
T_1	Safety Sensor response time in s
T_2	Safety interface response time in s, if used
T_3	Machine stopping time plus addition for deterioration in s
C	Additional distance because of the possibility of reaching over in mm

6.3.3 Additional distance "C" because of the possibility of reaching over

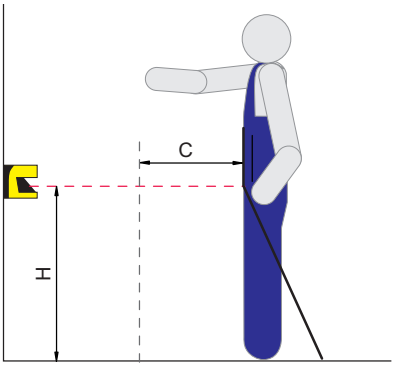
You prevent reaching the point of operation by reaching over with the additional distance "C":

$$C = 1200 - 0,4 \cdot H$$

H	Beam level height above the floor in mm
C_{MIN}	= 850 mm
H_{MAX}	= 1000 mm



Pic. 6.10: Beam level H = 300 mm, C = 1080 mm



Pic. 6.11: Beam level H = 875 mm to 1000 mm, C = 850 mm

6.3.4 Machine response times, stopping time

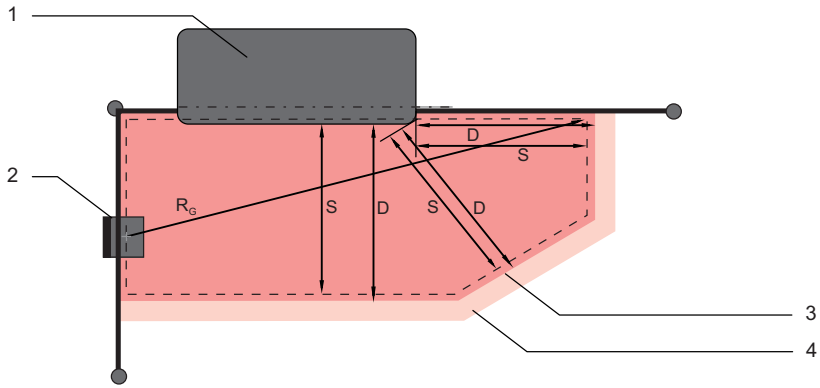
The Safety Sensor's rotary mirror rotates on its own axis every 40 ms. One revolution is a scan. At least two consecutive scans must be interrupted so that the safety-related switching outputs switch off. The Safety Sensor's minimum response time is therefore 80 ms.

If you want to increase the Safety Sensor's availability in an environment with fine particles, increase the number of interrupted scans after which the safety-related switching outputs switch off. With each additional scan the response time T_1 increases by 40 ms. With K = 1600 mm/s the safety distance increases by 64 mm per additional scan.

- Select a response time T_1 of at least 120 ms or higher.
- If you use a safety interface, take the response time T_2 from the safety interface's technical data.
- Determine the machine/system's stopping time T_3.
- If an increase in the stopping time within the regular test periods is to be expected, take an additional value into account for the machine's stopping time T_3.

6.3.5 Application-conditional additional distances for safety distance "S"

The protective field limits must be defined so that the calculated safety distance "S" to the point of operation, extended by the additional distances, is complied with "everywhere". Where this is not possible or does not make sense, you can use hard guards as supplementary measures.



Pic. 6.12: Defining the protective field contour for a stationary, horizontal protective field

1 Routing machine with free space for sensor protective field in the area under the machine table
2 Safety Sensor
3 Protective field contour
4 Warning field contour
S Calculated safety distance "S"
D Minimum distance "D" (= safety distance S + additional distance Z_{SM} + if required, Z_{REFL})
R_G Greater protective field radius without additional distances, measured from the rotation axis of the rotary mirror

↳ Define the limits of the protective field using the safety distance "S" without an additional distance.

↳ Determine the biggest protective field radius R_G for this protective field.

The biggest protective field radius determines the additional distance Z_{SM} for the system-conditional measurement error, by which the protective field contour must be enlarged.

The position of the rotary mirror's center point with regard to the housing is provided by the dimensional drawing (see figure 7.1, "Dimensions", page 65).

Table 6.1: Additional distance Z_{SM} for the protective field contour because of

measurement error

Biggest protective field radius R_G without additional distances	Additional distance Z_{SM}
< 3.5 m	83 mm
≥ 3.5 m	100 mm

- Avoid retro-reflectors at the beam level behind the protective field limit. If this is not possible, add another additional distance $\mathbf{Z_{REFL}}$ of **100 mm**.

6.3.6 Minimum distance "D" to the protective field contour

The minimum distance "D" is the distance between point of operation and protective field contour.

$$D = S + Z_{SM} + Z_{REFL}$$

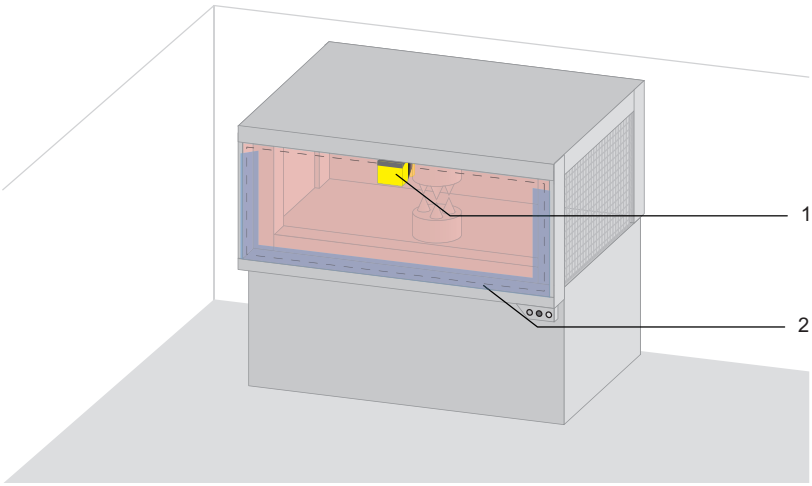
D Minimum distance between point of operation and protective field contour in mm

Z_{SM} Additional distance for system-conditional measurement error

Z_{REFL} Additional distance with retro-reflectors

- If the protective field runs up against fixed boundaries, such as walls or machine frames, take a countersinking into the machine contour of at least the size of the necessary additional distance Z_{SM}, and Z_{REFL} where required, into account. With the protective field contour under these conditions, stay about 50 mm away from the machine surface.
- If the protective field runs up against hard guards, ensure that the protective field ends under instead of in front of the hard guards. The width of the lower post must correspond with the size of the required additional distances.
- If all dangers in the fenced off area are covered by the Safety Sensor and the height of the beam level is 300 mm, you can raise the bottom edge of the hard guards from 200 mm to 350 mm. The protective field reaching to under the hard guards takes over the protective function of preventing an adult from crawling under in this case.
- Prevent obstructions within the calculated protective field limits. If this is not possible, implement protective measures so that the point of operation cannot be reached from out of the shadow of the obstruction.

6.4 Stationary point of operation guarding



Pic. 6.13: The Safety Sensor takes over the stop-activating and presence-detecting function if walking behind the protective field is not possible.

1 Safety Sensor
2 Reference contour

The following resolutions are required:

- Detection of an adult's hand: 30 mm
- Arm detection: 40 mm
  The required finger protection is ensured here by an additional distance "C", which depends on the resolution, in addition to the safety distance.

Procedure

↳ Calculate the necessary safety distance and determine the required additional distances for your application.

↳ In the configuration and diagnostics software, select the *hand protection* or *arm protection* presetting.

The protective field limits are automatically restricted as a result to the values listed in the technical data.

↳ Specify the protective field limits and define the areas that monitor the position of the protective field as reference contour.

6.4.1 Safety distance "S"

The B standard, ISO 13855/EN999 specifies the general formula for the safety distance as follows:

$$S = K \cdot (T_1 + T_2 + T_3) + C$$

S	Safety distance in mm
K	Approach speed in mm/s For normal approach on a vertically arranged protective field: 2000 mm/s
T_1	Safety Sensor response time in s
T_2	Safety interface response time in s, if used
T_3	Machine stopping time plus addition for deterioration in s
C	Additional distance in mm because of possible penetration into the protective field before the stop function activates

Depending on the calculated value of the safety distance, you must proceed differently with the result:

- If S is ≤ 500 mm, use the calculated result.
- If S is > 500 mm, calculate the safety distance again with the approach speed K = 1600 mm/s.

  If S is therefore ≥ 500 mm, use this value.

  If S is therefore S < 500 mm, use at least S = 500 mm.

6.4.2 Additional distance C

With a resolution less than 14 mm, a finger or the flat of a hand can penetrate a stretch into the protective field without the stop function activating. You must therefore include an additional distance "C".

$$C = 8 \cdot (d - 14)$$

d	Safety Sensor resolution (30 mm and 40 mm)

For 30 mm resolution the additional distance C = 128 mm; for 40 mm resolution C = 208 mm.

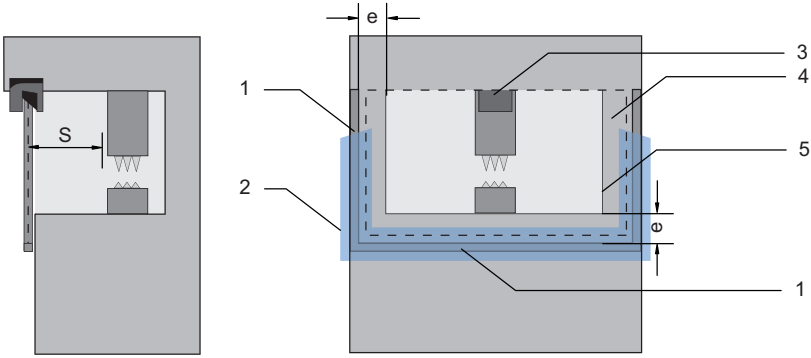
6.4.3 Machine response times, stopping time

The Safety Sensor's rotary mirror rotates on its own axis every 40 ms. One revolution is a scan. With each additional scan the response time T_1 increases by 40 ms. With K = 2000 mm/s approach speed this corresponds with an increase in the safety distance of 80 mm per additional scan. With K = 1600 mm/s it is 64 mm.

- Select a response time T_1 of at least 80 ms or higher.
- If you use a safety interface, take the response time T_2 from the safety interface's technical data.
- Determine the machine/system's stopping time T_3.
- If an increase in the stopping time within the regular test periods is to be expected, take an additional value into account for the machine's stopping time T_3.

6.4.4 Protective field and reference contour

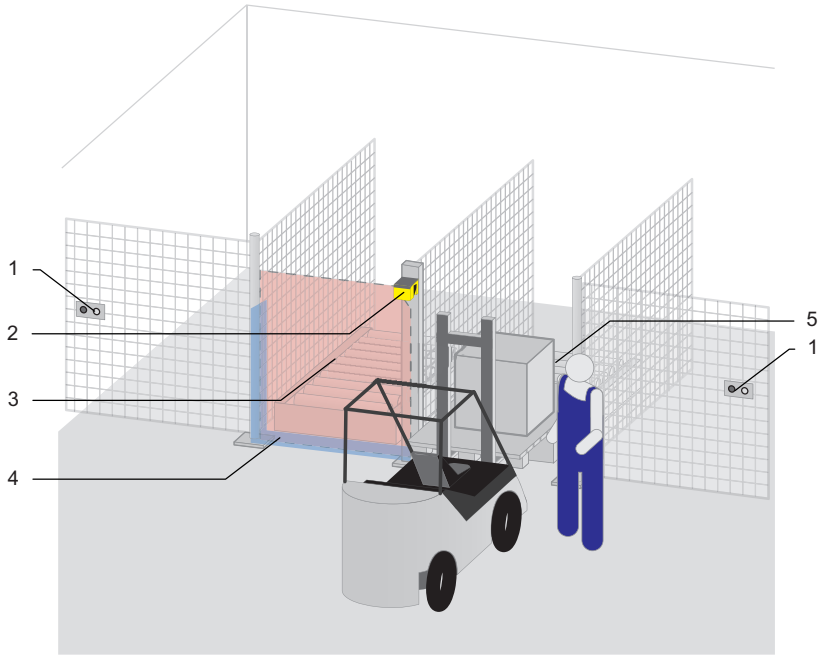
With a vertical protective field you must define at least two sides of the protective field contour as reference contour in accordance with IEC/EN 61496-3. The objective is to monitor the position of the protective field with regard to its marginal area. If the arrangement misaligns and the distance of the Safety Sensor to the reference surface changes as a result, switch the safety-related switching outputs off.



Pic. 6.14: Define the protective field and reference contour, stationary danger zone guarding, vertical protective field

1 Physical frame for reference contour
2 Reference contour, must seize at least two sides of the protective field
3 Safety Sensor
4 Distance "e" between the reference contour frame and machine opening, recommended: e ≥ 150 mm
5 Machine opening contour

6.5 Stationary access guarding



Pic. 6.15: Stationary access guarding, vertical protective field

1 EMERGENCY STOP control device and start/restart button
2 Safety Sensor
3 Protective field, left conveyor line, activated
4 Reference contour of the protective field
5 Protective field, right conveyor line, deactivated

The picture shows an input and output station with conveyor lanes in a danger zone. In this case three different protective fields are used:

- "Left conveyor lane" protective field
- "Right conveyor lane" protective field
- "Both conveyor lanes" protective field

The safety-set machine control system ensures the switchover between the protective fields.

You may only change over protective fields when additional measures prevent the passage through the respective inactive protective field. This can, for example, be the dimensions of a loaded palette, which makes it impossible to enter the danger zone during the switchover.

The vertical protective field of the access guarding only detects people during passage through. After the passage a start/restart interlock must ensure that the dangerous movement does not start again automatically.

Safety Sensors with a > 40 mm resolution are suitable for finger, hand and arm detection! The required protection for these body parts must be ensured with an additional distance C = 850 mm in addition to the safety distance. This distance is equivalent to average arm length.

Procedure

- Select the *start/restart interlock* function.
- Attach the start/restart button.
- Install an optical and/or acoustic start warning with the corresponding risk.
- Calculate the required safety distance.
- Specify the protective field limits and define the areas that monitor the position of the protective field as reference contour.

6.5.1 Safety distance "S"

The B standard, ISO 13855/EN999 specifies the general formula for the safety distance as follows:

$$S = K \cdot (T_1 + T_2 + T_3) + C$$

S	Safety distance in mm
K	Approach speed in mm/s For access guarding with vertical protective field: 1600 mm/s
T_1	Safety Sensor response time in s Maximal 0.080 s
T_2	Safety interface response time in s, if used
T_3	Machine stopping time plus addition for deterioration in s
C	Additional distance in mm With Safety Sensors with > 40 mm resolution at least 850 mm

6.5.2 Machine response times, stopping time

The Safety Sensor's rotary mirror rotates on its own axis every 40 ms. One revolution is a scan. An object must be detected in at least two consecutive scans so that the safety-related switching outputs switch off. The Safety Sensor's minimum response time is therefore 80 ms.

If you want to increase the Safety Sensor's availability in an environment with fine particles, increase the number of interrupted scans after which the safety-related switching outputs switch off. With each additional scan the response time T_1 increases by 40 ms. With K = 1600 mm/s the safety distance increases by 64 mm per additional scan.

- Select a response time T_1 = 80 ms.

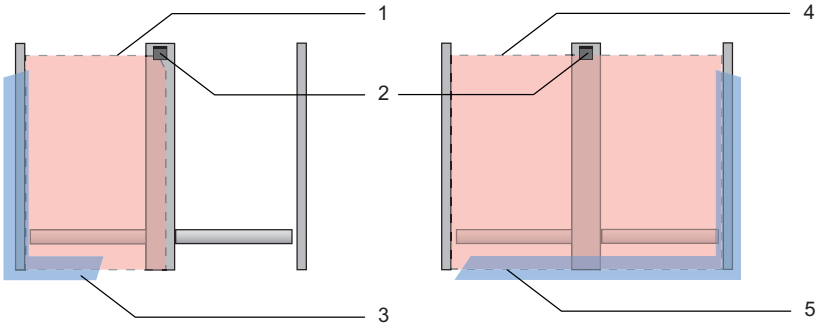
  Never define a value higher than 80 ms for T_1 for access guarding or passage controls. With higher values it can happen that a person might not be detected when passing through the protective field with an approach speed of 1600 mm/s.

  If you select the *access guarding* presetting in the configuration and diagnostics software, T_1 is automatically set to 80 ms.

- If you use a safety interface, take the response time T_2 from the safety interface's technical data.
- Determine the machine/system's stopping time T_3.
- If an increase in the stopping time within the regular test periods is to be expected, take an additional value into account for the machine's stopping time T_3.

6.5.3 Protective field and reference contour

With a vertical protective field you must define at least two sides of the protective field contour as reference contour in accordance with IEC/EN 61496-3. The objective is to monitor the position of the protective field with regard to its marginal area. If the arrangement misaligns and the distance of the Safety Sensor to the reference changes as a result, switch the safety-related switching outputs off.



Pic. 6.16: Define the protective field and reference contours, stationary access guarding, vertical protective field

1 Protective field contour PF1, guards the "left conveyor lane"
2 Safety Sensor
3 Reference contour of PF1, left frame and floor
4 Protective field contour PF2, guards "both conveyor lanes"
5 Reference contour of PF2, right frame and floor

- In the configuration and diagnostics software select the *access guarding* presetting before configuring the protective fields. The software consequently requests a reference contour on at least two sides of the protective field.
- When defining the protective field ensure that there are no gaps bigger than 150 mm.
- When defining the protective field limits specify, the sectors that monitor the position of the protective field as reference contour.

6.6 Mobile danger zone guarding on AGVs

Danger zone guarding protects people and objects that are in rooms in which vehicles move in, e.g. automated guided vehicle systems (AGVs).

⚠ WARNING

Danger of injury because of insufficient vehicle stopping distance

- The company operating the machine must use organizational measures to prevent people from entering the protective field of the vehicle from the sides or being able to move towards an approaching vehicle.

Procedure

- Only install the Safety Sensor on the front of the vehicle.

  If you must also guard the reverse travel, you must also install a Safety Sensor on the rear of the vehicle.
- Select 70 mm resolution.
- Do not set the height higher than 200 mm above the floor.

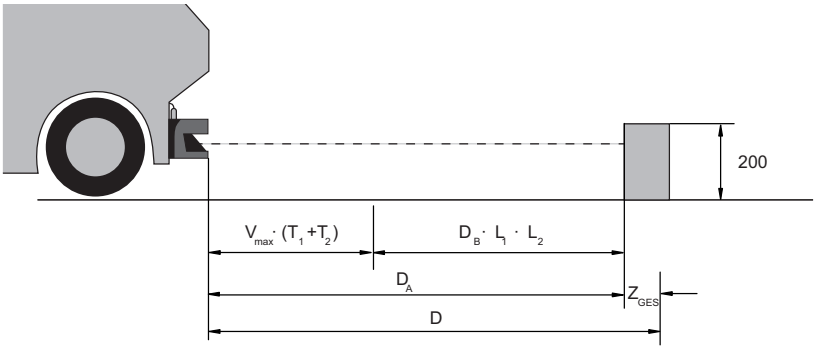
  A person lying on the floor can therefore be safely detected. This is required by the C standard, EN 1525 "Safety of industrial trucks – Driverless trucks and their systems".
- Set the protective field length so that the response time until braking and the braking distance, including factors for wear and tear and floor conditions, and any necessary additional distances are taken into account.

6.6.1 Basic requirements

- Only use the Safety Sensor on vehicles with electrical drive and electrically influenced drive and braking devices.
- Mount the Safety Sensor on the vehicle so that there are no unmonitored areas ≥ 70 mm between the protective field and vehicle front.

6.6.2 Minimum distance D

The horizontally arranged protective field protects people and objects that are in the vehicle's path and are detected by the front edge of the protective field.



Pic. 6.17: Mobile danger zone guarding, required minimum distance D calculation

- Configure an upstream warning field that reduces the vehicle's speed.

  A full brake with a subsequent interruption of the protective field is then executed moderately and is less demanding on the vehicle's drives.

- Dimension the minimum distance D for the maximum speed as if the speed reduction initiated by the warning field had not happened.

  Only when the protective field is interrupted do the safety-related switching outputs switch off and safely brake the vehicle.

Stopping distance D_A

$$D_A = v_{max} \cdot (T_1 + T_2) + D_B \cdot L_1 \cdot L_2$$

D_A	Stopping distance in mm
v_{max}	Maximum vehicle speed in mm/s
T_1	Safety Sensor response time in s
T_2	AGV response time in s
D_B	Braking distance with v_{max} and maximum vehicle load in mm
L_1	Factor for brake wear and tear
L_2	Factor for problematic floor conditions, e.g. dirt, wet conditions

Additional distances Z

$$Z_{Ges} = Z_{SM} + Z_F + Z_{REFL}$$

Z_{Ges} Total of the required additional distances

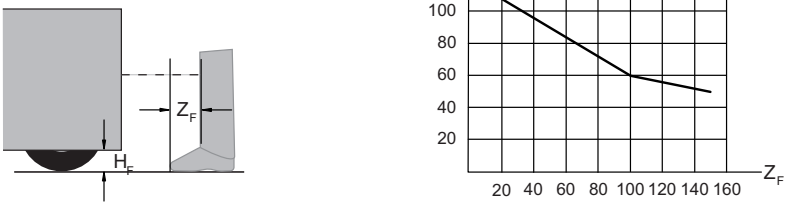
Z_{SM} Additional distance for system-conditional measurement error, see Table 6.1 on page 45

Z_F Additional distance required with lack of floor space H_F in mm

Z_{REFL} Additional distance required with retro-reflectors beyond the protective field limits Z_{REFL} = 100 mm

The **additional distance Z_{SM}** is always required. Its size depends on the biggest radius R_G from the Safety Sensor mirror's rotary axis to the protective field limit without Z_{Ges}. The position of the rotary mirror axis depends on the installation situation.

The **additional distance Z_F** is required if the vehicle does not have enough free floor space H_F and there is therefore no space under the vehicle or the Safety Sensor for the tips of the feet. You determine the additional distance Z_F according to the following diagram:



Pic. 6.18: Diagram for determining the additional distance Z_F with lack of floor space H_F

If wheels are mounted near the side wall, always add an additional distance $Z_F \geq$ 150 mm.

Minimum distance D

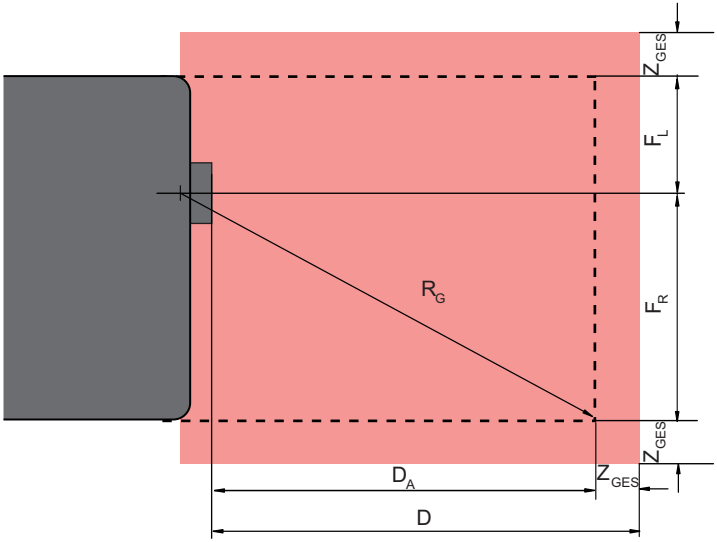
$$D = D_A + Z_{Ges}$$

D Minimum vehicle front distance (danger) to the protective field front edge in mm

D_A Stopping distance in mm

Z_{Ges} Total required additional distances

6.6.3 Protective field dimensions



Pic. 6.19: Mobile danger zone guarding, dimensions for horizontal protective field

D Minimum distance, vehicle front (danger) to protective field front edge
D_A Stopping distance
Z_{Ges} Total required additional distances to the front and for both sides
F_L Distance, Safety Sensor center to the left vehicle edge
F_R Distance, Safety Sensor center to the right vehicle edge
R_G Biggest radius in the protective field Z_{GES} for determining the additional distance Z_{SM}

- Arrange the protective field symmetrically with reference to the vehicle width, even if the Safety Sensor is not arranged centered.
- Take the required free space for overlaying side protective fields under the conveyor lanes along the vehicle's path into account.
- If you have to expect angle deviations of the vehicle during the travel, plan an additional tolerance range to guarantee undisturbed travel operation.

6.6.4 Test mode for *MotionMonitoring*

You require a special test mode to be able to check the *MotionMonitoring* function with the daily function check.

Configure this test mode in the control system as follows:

- Control system selects protective field 1
- Control system moves vehicle with speed for protective field 2

Alarm output 2 must signal that the speed will be exceeded.

6.7 Mobile side guarding on AGVs

⚠ WARNING

Danger of injury because of insufficient vehicle stopping distance

↳ The company operating the machine must use organizational measures to ensure that people cannot enter the vehicle's protective field from the side.

↳ For mobile vertical protective fields use a resolution of at least 150 mm.

↳ Position the protective field edges in the travel direction in accordance with the front protective field edge of the horizontal protective field (see chapter, "Protective field dimensions", page 58).

↳ Ensure that the response time of all components of the switch-off circuit are the same or balance the response times with different protective field dimensioning.

↳ Set the vertical protective fields at a slight angle so that the lower protective field edges protrude over the vehicle width by the amount of the additional distances, Z_{SM}, Z_F and Z_{REFL} where required (see figure 6.19, "Mobile danger zone guarding, dimensions for horizontal protective field", page 58).

7 Technical data

7.1 Safety

Safety type in acc. with IEC/EN 61496	Type 3
Performance level PL (EN ISO 13849-1)	PL d
Safety Integrity Level SIL (IEC/EN 61508) SILCL (IEC 62061)	SIL2
PFH_d Probability of dangerous failures per hour (EN ISO 13849-1)	1.5 E-7
Category in acc. with EN 954-1/EN 13489-1	3
Service life T_M in years	20
Approvals	CE TÜV SÜDDEUTSCHLAND Functional Safety

7.2 Optics

Laser protection class in acc. with EN 60825-1	Class 1
Wavelength	905 nm
Repetition frequency	25 kHz
Scan rate	25 scans/s, equal to 40 ms/scan
Scanning angle	Max. 190°
Angle resolution	0.36°
Lateral tolerance without mounting system	± 0.18° (with reference to the housing rear panel)
Lateral tolerance with mounting system	± 0.22° (with reference to the housing rear panel)

7.3 Protective field

	Variant SIMATIC				
	FS620I SR	**FS670 SR**	**FS620I**	**FS660 FS670**	**FS660 LR FS670 LR**
Number of field pairs	4	8	4	8	8
Reference contour can be selected	x	x	–	x	x
Protective field range					
At 30 mm resolution	–	–	–	1.60 m	1.60 m
At 40 mm resolution	–	–	–	2.20 m	2.20 m
At 50 mm resolution	–	–	–	2.80 m	2.80 m
At 70 mm resolution	2.15 m	2.15 m	4.00 m	4.00 m	6.25 m
At 150 mm resolution	2.15 m	2.15 m	4.00 m	4.00 m	6.25 m
Minimum range that can be set	200 mm				
Detection range of the test object from the housing edge	The detection capability is restricted in the 0 mm to 50 mm range to increase availability.				
Diffuse reflectance PF minimum	1,8 %				

7.4 Warning field

Number of field pairs	See "Protective field" on page 61.
Warning field range	0 - 15 m
Object size	150 mm x 150 mm
Diffuse reflectance WF minimum	Min. 20 %

7.5 Measured data

Measurement range	0 - 50 m
Diffuse reflectance	20 %
Radial resolution	5 mm
Lateral resolution	0.36°

7.6 Electrical power supply

Voltage supply	24 V DC (+20 % / -30 %) Power supply in acc. with IEC 742 with safe supply isolation and compensation with voltage dips of up to 20 ms in acc. with EN 61496-1.
Overcurrent protection	Via 1.6 A fuse melting fuse in the cabinet
Current consumption	Approx. 420 mA (use power supply with 2.5 A)
Current consumption	10 W with 24 V plus output load
Overvoltage protection	Overvoltage protection with safe limit stop
Protective earth conductor	Connection not permitted
Interface X1 connector plug	SUB-D15
Interface X2 connector plug	SUB-D9

Inputs

Start/restart	+24 V opto-uncoupled, dynamically monitored
Field pair switchover	Selection of 4 or 8 field pairs via 4 control lines, +24 V opto-uncoupled, dynamically monitored, logically 1 = field pair activated
Signal definition: High/logical 1 Low/logical 0	 16 - 30 V < 3 V

Safety outputs

OSSD transistor safety-related switching outputs	2 safe PNP semiconductor outputs Short circuit-proof, cross-circuit monitored		
	Minimum	Typical	Maximum
Switching voltage high active	U_B - 3.2 V		
Switching voltage low			2.0 V
Switching current			250 mA
Cut-off frequency f_g			1 kHz
Load capacity C_{load}			100 nF
Cable length between Safety Sensor and load with gauge 0.5 mm^2			50 m
Permitted wire gauge	0.5 mm^2		
Test pulse width			100 µs
Test pulse distance	5 ms		

Interfaces

Data interface X2	RS 232 (max 10 m), RS 422 (twisted pair, max. 50 m)
AS-Interface Safety at work	Optional: All variants FS600, except FS600 SR
PROFIBUS DP PROFIsafe	Optional: All variants FS600, except FS600 SR

Control outputs

Warning field/dirt/fault	2 x PNP transistor outputs, configurable
Max. switching current	100 mA
Alarm high active	U_B- 4 V
Alarm low inactive	< 2.0 V
Permissible cable length with 0.5 mm^2	50 m, shielded, only connect shield in the cabinet with PE

7.7 Software

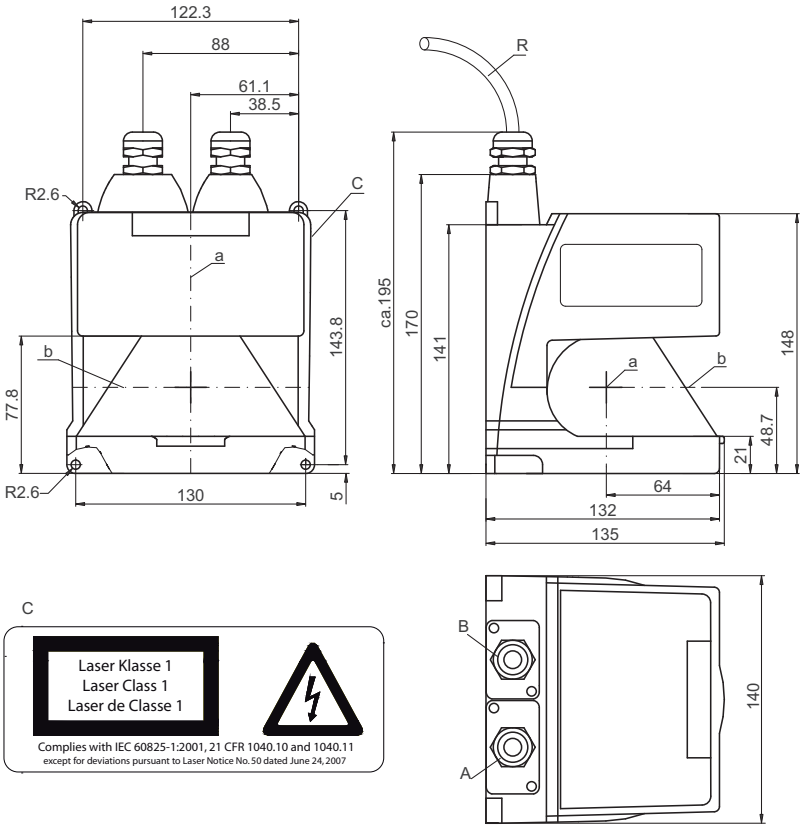
Configuration and diagnostics software	LS4soft under Windows 95/98/2000/NT/XP

7.8 Ambient conditions

Type of protection	IP 65 in acc. with IEC 60529
Safety class	II
Ambient temperature, operation	0 to + 50 °C
Ambient temperature, storage	-20 to +60 °C
Humidity	DIN 40040, table 10, code letter E (reasonably dry)
Interference immunity	In acc. with DIN EN 61496-1 (type 4), Also in acc. with DIN 40839-1/3 test pulses 1, 2, 3a, 3b and 5
Vibration stress over 3 axes	In acc. with IEC 60068 part 2 - 6, 10 - 150 Hz max 5 G
Permanent shock over 3 axes	In acc. with IEC 60068 part 2 - 29, 10 G, 16 ms
Disposal	Specialist disposal required

7.9 Dimensions, weight

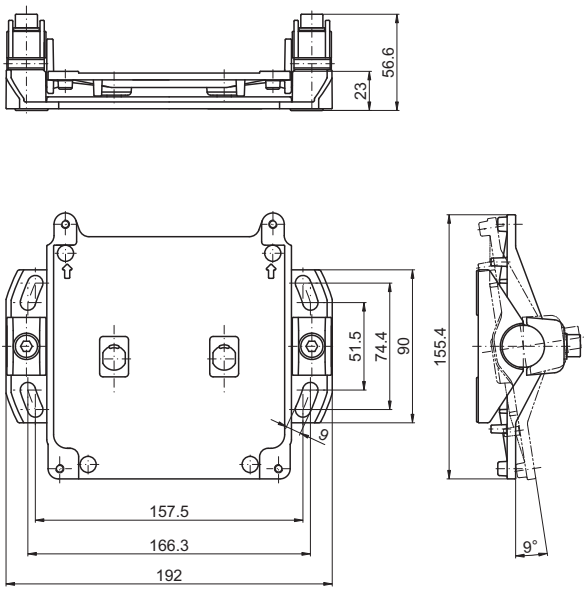
Housing	Aluminum diecast, plastic
Standard version dimensions (ensure free space for plug with fixing and cable)	140 x 155 x 135 (W x H x D) in mm Details, see Figure 7.1 "Dimensions"
Standard version weight	Approx. 2 kg
Distance, beam level center to the bottom housing edge	48.75 mm
Distance, bottom housing edge to the rotary mirror axis	67 mm



Pic. 7.1: Dimensions

R Bending radius of the connected cable
a Rotary mirror axis
b Beam level
A Interface X1 for connection with control system
B Interface X2 for connection with PC or laptop
All dimensions in mm.

Mounting system (option)



Pic. 7.2: Mounting system dimensions

All dimensions in mm.

8 Electrical connection

The Safety Sensor may only be connected and integrated into the machine's control system by an appropriately qualified person.

↳ Observe the safety notes (see chapter, "Safety", page 13) and technical data (see chapter, "Technical data", page 60).

↳ Ensure that the voltage supply and all connected input and output current circuits have safe mains isolation in acc. with IEC 742.

The safety-related switching output is redundantly configured.

↳ Basically you always connect both safety-related switching outputs (OSSDs) with the machine's switch-off circuit so that they are both separately fully effective for switching off the dangerous movement (see chapter, "Integrating the Safety Sensor into machine control system", page 73).

You may not use the alarm outputs for switching safety-relevant signals.

8.1 Electrical power supply

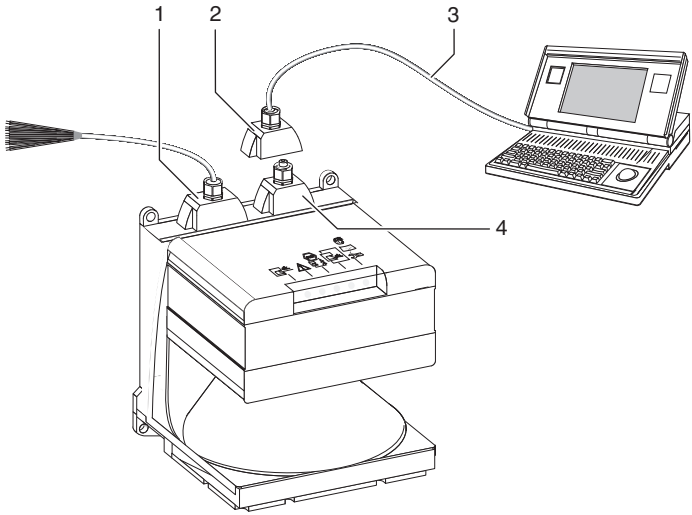
(see chapter, "Electrical power supply", page 62)

8.2 Interfaces

The Safety Sensor has two interfaces:

- Interface X1 for connection with the control system
- Interface X2 for connection with PC or laptop

Interface	Type	Function
X1	SUB-D15	• Power supply • Switching lines and signal lines
X2	SUB-D9	Configuration interface and data interface: • Parameter configuration • Protective field definition and warning field definition • Data transfer and measured value transfer • Diagnostics



Pic. 8.1: Safety Sensor interfaces

1 X1 plug
2 X2 plug
B X2 cable for connection with PC/laptop
4 Protective housing, if no PC/laptop connected

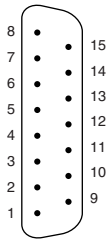
The plug housings are included with delivery. A protective housing is also included for the X2 interface. The protective housing protects interface X2 if no PC is connected.

Screw the plug and protective housing on tight to prevent dust and moisture from penetrating.

The protective housing consists of:

- Housing with seal ring and fixing bolts
- M16 cable gland with dummy plugs
- Plug with solder connection

8.2.1 X1 plug interface assignment



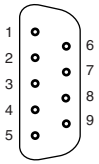
Pic. 8.2: X1 plug interface assignment

PIN	Color code	Signal	Description
1	Black	GND	Supply voltage earth
2	Blue	Restart	Input, Safety Sensor reset and start/restart button connection
3	Red	U_B	Supply voltage
4	Orange	FP 1	Control input for activating field pair 1
5	Yellow	Alarm 1	Semiconductor output with switch-off with: • Warning field interruption • Warning message, e.g. "Front screen slightly dirty" • Fault message, e.g. "Front screen very dirty" • Internal fault You can combine the functions.
6	Green	FP 2	Control input for activating field pair 2
7	Purple	FP 3	Control input for activating field pair 3
8	Gray	FP 4	Control input for activating field pair 4
9	n.c.	NC	Do not assign
10	n.c.	NC	Do not assign
11	White	OSSD 1	Semiconductor output channel 1, switch-off with protective field interruption
12	White/black	OSSD 2	Semiconductor output channel 2, switch-off with protective field interruption

PIN	Color code	Signal	Description
13	n.c.	NC	Do not assign
14	White/brown	NC	Do not assign
15	Brown	Alarm 2	Semiconductor output with switch-off with: • Warning field interruption • Warning message, e.g. "Front screen slightly dirty" • Fault message, e.g. "Front screen very dirty" • Internal fault You can combine the functions.

8.2.2 Interface assignment, plug X2

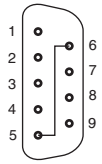
Plug X2 as RS 232 port



Pic. 8.3: Plug X2 interface assignment as RS 232 port

PIN	Signal	Description
1	- - -	Reserved
2	TxD	Data communication, send
3	RxD	Data communication, receive
4	- - -	Reserved
5	GND/shield	Ground/shield
6	RS 232	Reserved
7	NC	Do not assign
8	NC	Do not assign
9	Reserved	Reserved for test purposes

Plug X2 as RS 422 port



Pic. 8.4: Plug X2 interface assignment as RS 422 port

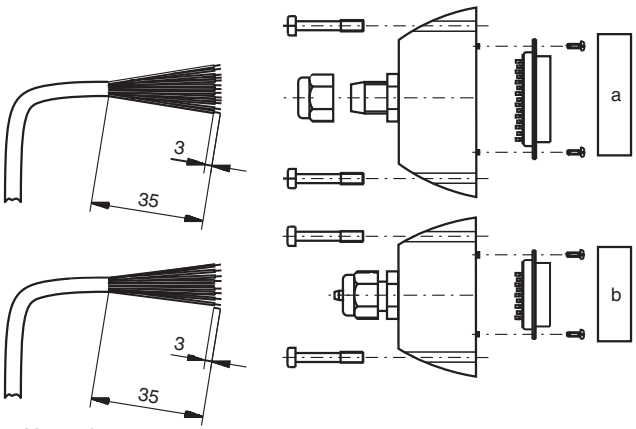
PIN	Signal	Description
1	Tx+	Data communication, send
2	Tx-	Data communication, send
3	Rx-	Data communication, receive
4	Rx+	Data communication, receive
5	GND/shield	Ground/shield
6	RS 422	Selection as interface RS 422 via jumper to pin 5
7	NC	Do not assign
8	NC	Do not assign
9	Reserved	Reserved for test purposes

8.3 Assemble cables

You can either use the plug housing included with delivery and assemble the cables yourself, or you can use already assembled cables.

Control cables with ConfigPlug integrated in the plug, for example, are available as accessories. ConfigPlug saves the configuration and transfers this automatically to the Safety Sensor.

Only use shielded cables.



a X1 socket
b X2 plug

The cable glands permit cable diameters of 6.5 to 10.5 mm.

Assemble X1 cable

Table 8.1: X1 cable requirements

Plug	SUB-D, 15-pin
Socket	SUB-D, 15-pin
Wire gauge	Min. 0.5 mm^2
Cable external diameter	6.5 mm to 10 mm
Cable length	Max. 50 m

Assemble X2 cable

Table 8.2: X2 cable requirements

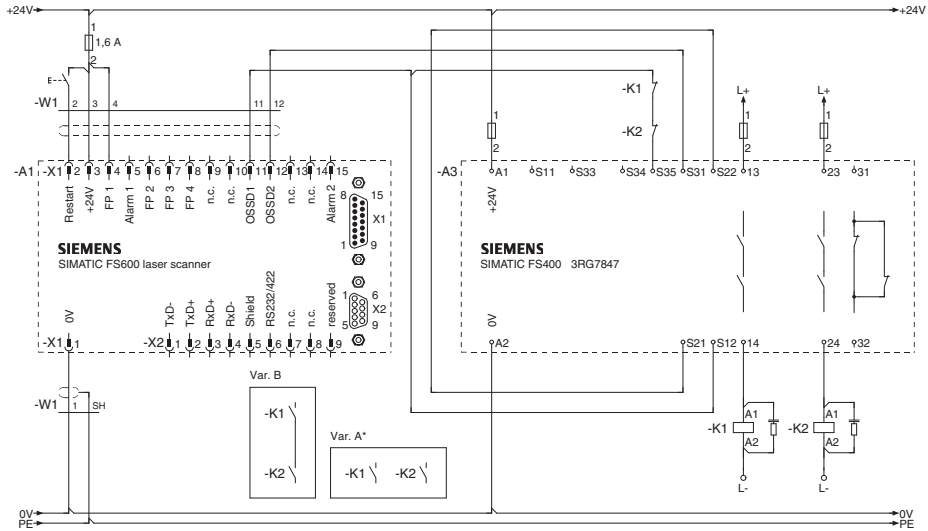
Plug	SUB-D, 9-pin
Socket	SUB-D, 9-pin
Wire gauge	Min. 0.2 mm^2 or 24 AWG
Cable external diameter	6.5 mm to 10 mm
Cable length	RS 232: Max. 10 m RS 422: Max. 50 m, data lines 1 and 2 plus 3 and 4 twisted pair

8.4 Integrating the Safety Sensor into machine control system

The following examples show options for integrating the Safety Sensor into the machine control system.

As soon as you have connected the operating voltage and activated a protective field the Safety Sensor is ready for operation.

8.4.1 Downstream safety circuit with start/restart interlock, contactor monitoring, without field pair switchover



Pic. 8.5: Connection example with external start/restart interlock and contactor monitoring, without field pair switchover

* Release circuits for the dangerous movement:
Integrate these contacts into the control system so that the dangerous state is removed when the contact is open.

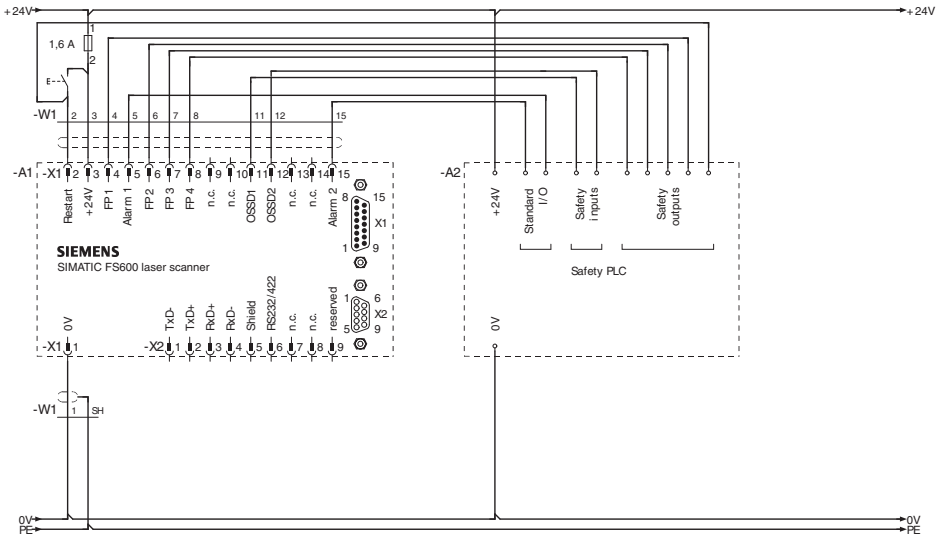
Applications in acc. with category 3 or 4 in acc. with EN 954-1 require a two-channel integration (see var. A).

Variant B shows a single-channel integration.

The monitoring of the downstream contactors K1 and K2 (contactor monitoring, EDM) is implemented in this connection example with the integration of the rest contacts K1 and K2.

8.4.2 Programmable logic controller (PLC) with corresponding safety level and field pair switchover

The safety level corresponds with at least category 3 in acc. with EN 954.



Pic. 8.6: Example of a connection with a safe PLC with corresponding safety level (min. category 3, EN 954) and field pair switchover.

9 Parameters

You enter all parameters for the Safety Sensor's configuration in the software (see "Safe parametering" instructions).

The Safety Sensor is configured at the factory with the maximum protective field and activated start/restart interlock. Configure the Safety Sensor according to your application.

9.1 Administrative parameters

9.1.1 Safety Laser Scanner name

The *Safety Laser Scanner name* parameter unambiguously names the Safety Sensor.

Settings

- Max. 20 characters
- No default value.

9.1.2 Description

The *Description* parameter contains further information for clearly assigning the Safety Sensor. You can, for example, provide the Safety Sensor's precise point of use.

Settings

- Max. 100 characters
- No default value.

9.1.3 Start segment output

The *Start segment output* parameter names the segment of the measured contour that will be shown first.

Settings

- Settable value: 0 to 528
- Default value: 0

For showing 180° use the value 14 as start segment.

For showing 190° use the value 0 as start segment.

9.1.4 Stop segment output

The *Stop segment output* parameter names the segment of the measured contour that will be shown last.

Settings

- Settable value: 0 to 528
- Default value: 528

For showing 180° use the value 514 as stop segment.

For showing 190° use the value 528 as stop segment.

9.1.5 Output resolution

The *Output resolution* parameter provides the number of measured values per section shown. The respective smallest measured values are connected with one another with the display on the monitor.

Settings

- Settable value: 1 to 8
- Default value: 4

If you want a detailed contour display, enter 1. If you want a smoothed out and quicker updated contour display, enter 8.

9.1.6 Serial interface baud rate

The *Serial interface baud rate* parameter provides the transfer rate between the Safety Sensor and the PC.

Settings

- Settable value: 9600 to 115200 baud
- Default value: 57600 baud

The set value must agree with the PC's transfer rate.

9.1.7 Alarm incident

The *Alarm incident* parameter provides the incident at which the Safety Sensor will switch off alarm outputs Alarm 1 and Alarm 2.

Settings

- Device warning
- Warning field interrupted
- Device warning or warning field interrupted
- None
- Default value: Warning field interrupted

9.1.8 Precalculated measured values output

The *Precalculated measured values output* parameter determines whether the Safety Sensor will issue the distance measured value and the speed precalculated from it via the serial interface.

Settings

- Activated
- Deactivated
- Default value: Deactivated

The first segment is always 90° (straight). You can provide two more segments for the measured value calculation.

9.1.9 2nd measured value calculation segment

The *2nd measured value calculation segment* parameter provides the second segment, for which the distance and precalculated speed will be issued.

Settings

- 0 - 528
- Default value: 14

9.1.10 3rd measured value calculation segment

The *3rd measured value calculation segment* parameter provides the third segment, for which the distance and precalculated speed will be issued.

Settings

- 0 - 528
- Default value: 514

9.2 Safety-relevant parameters

9.2.1 Application

The *Application* parameter provides the usage scenario that the Safety Sensor will be configured for.

Settings

You can select from the following applications. Depending on the set application, the parameters "Resolution" and "Start/restart interlock" are preset:

Selectable application	Resolution	Start/restart interlock
Danger zone guarding	70 mm	Activated
Leg detection	50 mm	Activated
AGV	70 mm	Deactivated, restart automatic with 2000 ms delay
MotionMonitoring	70 mm	Deactivated, restart automatic with 2000 ms delay
Passage control	150 mm	Activated
Arm protection	40 mm	Activated
Hand protection	30 mm	Activated
Body protection	150 mm	Activated
Freely selectable Presettings	Activated	Activated

Default value: Danger zone guarding

9.2.2 Response times

The *Response times* parameter provides the time until the Safety Sensor switches off the OSSD 1 and OSSD 2 safety-related switching outputs or the alarm output with warning and protective field interruptions.

You provide two response times:

- PF response time: Time until the Safety Sensor switches off the OSSD 1 and OSSD 2 safety-related switching outputs.
- WF response time: Time until the Safety Sensor switches off the alarm output.

Settings

- Multiple of 40 ms, in the 80 ms - 640 ms range
- Default values:
  - PF response time: 80 ms
  - WF response time: 80 ms

9.2.3 Dust suppression

The *Dust suppression* parameter indicates whether or not the *Dust suppression* function is activated.

Settings:

- Activated
- Deactivated
- Default value: Activated

9.2.4 Vehicle speed

The *vehicle speeds* parameter specifies the range the maximum speed of your AGV is in.

Settings:

- Up to 1,500 mm/s
- Up to 2,500 mm/s
- Up to 4,000 mm/s
- Over 4,000 mm/s
- Default value: Over 4,000 mm/s

9.2.5 Applicable field pair selection with scanner start

The *Applicable field pair selection with scanner start* parameter indicates which field pair may be active when the Safety Sensor starts.

Settings

You select the applicable field pairs in a matrix:

- x: Field pair allowed with start
- Empty field: Field pair forbidden with start
- Default values: Field pairs 1, 2, 3 and 4 allowed

9.2.6 Permitted field pair switchovers

The *Permitted field pair switchovers* parameter indicates the switchover from field pair to field pair that is permitted and in which sequence. With forbidden switchover sequences the Safety Sensor stops the machine.

Settings

You select the permitted field pair switchovers in a matrix:

- x: Field pair switchover permitted
- Empty field: Field pair switchover forbidden
- Default values: No field pair switchover allowed

9.3 Field pair

9.3.1 Protective field/description

The *Description* parameter names the protective field.

Settings

- Max. 20 characters
- Default values: SF1 to SF4

9.3.2 Warning field/description

The *Description* parameter names the warning field.

Settings

- Max. 20 characters
- Default values: WF 1 to WF 4

9.4 MotionMonitoring

9.4.1 Vehicle width

The *Vehicle width, left* and *Vehicle width, right* parameters provide the width of the vehicle from the rotary mirror axis of the Safety Sensor to the vehicle side.

Settings

- 100 mm - 6000 mm
- Default value: 100 mm

The total of the *Vehicle width, left* and *Vehicle width, right* values must be at least the overall vehicle width.

9.4.2 Protective field side additional distance

The *Protective field side additional distance* parameter provides the safety distance between a vehicle side and the protective field.

Use a protective field side additional distance if people can approach the vehicle from the side.

Settings

- 25 mm - 6000 mm
- Default value: 100 mm

9.4.3 Laser scanner installation point

The *Laser scanner installation point* parameter provides the point at which the Safety Sensor is installed on the vehicle front.

The software calculates the rear limit of the protective fields and warning fields on the basis of the setting.

Settings

- Countersunk
- Without mounting system
- With mounting system
- Default value: With mounting system

9.4.4 Warning field prerun time

The *Warning field prerun time* parameter provides the amount of time between the interruption of the warning field and the interruption of the protective field, regardless of the speed of the respective protective field.

The software calculates the warning field size with the warning field prerun time, depending on the protective field size.

Settings

- 1 ms - 5000 ms
- Default value: 1500 ms.

9.4.5 Vehicle response time

The *Vehicle response time* parameter provides the time from switching off the Safety Sensor until the braking starts.

It is the combined response times of all components of the switch-off circuit, e.g. safety modules, safety relays.

Settings

- 10 ms - 640 ms
- Default value: 300 ms.

9.4.6 Brake wear and tear additional distance

The *Brake wear and tear additional distance* parameter provides the factor by which the braking distance is extended by wear and tear components, which are integrated into the braking process.

Settings

- 0 % - 100 %
- Default value: 10 %

9.4.7 Ambient influences additional distance

The *Ambient influences additional distance* parameter provides the factor by which the braking distance is extended by ambient influences, e.g. by wet conditions or dust on the path covering.

Settings

- 0 % - 100 %
- Default value: 10 %

9.4.8 Speed with PF

The *Speed with PF x* parameter provides the maximum speed that the vehicle reaches with this protective field.

Settings

- Maximum value: 8000 mm/s

If you enter the *Speed with PF x* parameter for several protective fields, the difference between the protective fields must be at least 100 mm/s.

The software calculates the required protective field length from the *Speed with PF x* and *Braking distance with PF x* parameters.

9.4.9 Braking distance with PF

The *Braking distance with PF x* parameter provides the braking distance that the vehicle requires to come to a standstill with maximum speed with this protective field.

Settings

- Maximum value: Scanner range in mm

Provide the parameter for the protective field in which the vehicle has the highest maximum speed. The software interpolates all other braking distances.

9.4.10 Standstill monitoring

The *Standstill monitoring* parameter indicates whether or not further travel blocking in the *MotionMonitoring* function is activated.

Settings

- Activated
- Deactivated
- Default value: Deactivated

9.4.11 Creep and reverse

The *Creep and reverse* parameter indicates whether creep and reverse is activated in the *MotionMonitoring* function.

Settings

- Activated
- Deactivated
- Default value: Deactivated

10 Start-up

10.1 Before first start-up

In accordance with IEC TS62046 and national regulations, such as EU Directive 89/655 EEC, for example, tests are prescribed in the following situations:

- Before first start-up
- Following machine modifications
- After long machine standstill
- After a Safety Sensor upgrade of re-configuration

10.2 Switching on

Requirements:

- You have configured the Safety Sensor with the configuration and diagnostics software and transferred the configuration to the Safety Sensor.
- Interface X1 of the the Safety Sensor is connected to the control system or safety switching device.
- Protective housing is mounted on interface X2.

⚠ CAUTION

Danger of injury with unpredictable machine behavior with first start-up.

↳ Ensure that nobody is in the machine's danger zone.

↳ Start the machine.

↳ Press the start/restart button if the *start interlock* function is activated.

or

If the *start test* function is activated, interrupt the protective field and release it again. The machine then starts automatically.

10.3 Shutting down

Shut the machine with the Safety Sensor down temporarily

When you shut down the machine with the Safety Sensor temporarily, you do not have to observe any more steps. The Safety Sensor saves the configuration and starts again with the switch-on with this configuration.

Shut down Safety Sensor and remove from machine

When you shut down the Safety Sensor and store it away for a later use, you must reset the Safety Sensor to the factory settings.

↳ Reset the Safety Sensor to the factory settings (see instructions, "Safe parametering").

10.4 Restart

Restarting the machine with the Safety Sensor

If you have only shut down the system with the Safety Sensor temporarily and are restarting the system without any changes, you can restart the Safety Sensor with the configuration that applied with the shutdown. The configuration remains saved in the Safety Sensor.

↳ Perform a function check (see chapter, "Daily functions test", page 91).

Start up machine with Safety Sensor after modification or reconfiguration.

If you have performed significant changes on the machine or have reconfigured the Safety Sensor, the Safety Sensor must be checked as with the first start-up.

↳ Test the Safety Sensor (see chapter, "Testing before first start-up and after machine modification", page 88).

10.5 Starting up the replacement device

The replacement device and the device being replaced must agree as follows:

- Device type upward compatible in accordance with specification plate or with previous device with greater range and greater scope of function.
- Installation position
- Alignment

Mount and align replacement device

- Mount the replacement device at the previous Safety Sensor's position.
- Align the Safety Sensor as with the previous Safety Sensor.

Transfer configuration to replacement device

You have two options for transferring the configuration to the replacement device:

- When using the ConfigPlug by attaching the ConfigPlug to the replacement device.
- With the configuration and diagnostics software

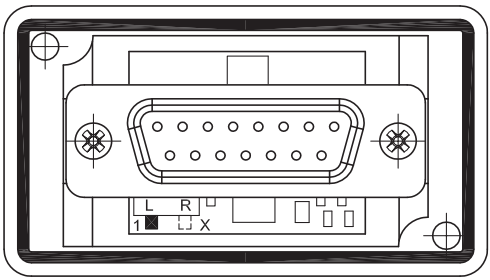
Transfer configuration with the PC

- Connect the Safety Sensor's X2 interface with the PC.
- Transfer the configuration to the replacement device (see also, "Safe parametering" instructions).

Use ConfigPlug

The ConfigPlug has a switch that determines the transfer direction of the configuration:

Switch setting	Transfer direction
1	The ConfigPlug overwrites the Safety Sensor's configuration.
X	The configuration saved in the ConfigPlug is overwritten.



- Set the switch in the plug to position 1.
- Attach the ConfigPlug to interface X1.

  The ConfigPlug transfers the configuration to the Safety Sensor when the Safety Sensor is started. A brief flashing of the two yellow LEDs 2 and 5 confirms the successful transfer of the configuration.
  The replacement device is not compatible if the Safety Sensor displays a fault.

Test the replacement device

The replacement device test depends on whether you use the ConfigPlug or have transferred the configuration with the PC to the Safety Sensor.

- If you have used the ConfigPlug, test the Safety Sensor using the checklist for the daily test.

  or

  If you have transferred the configuration with the PC, check the Safety Sensor in accordance with the first startup (see chapter, "Before first start-up", page 84).

11 Testing

11.1 Testing before first start-up and after machine modification

In accordance with IEC TS62046 and national regulations, such as EU Directive 89/655 EEC, for example, tests are prescribed in the following situations:

- Before first start-up
- Following machine modifications
- After long machine standstill
- After a Safety Sensor upgrade or re-configuration

⚠ WARNING

Danger of serious injury through unpredictable machine behavior with first start-up.

↳ Ensure that nobody is in the machine's danger zone.

↳ Check the effectiveness of the switch-off function in accordance with the following checklist in all of the machine's operating modes along the defined protective field contour. With automated guided vehicle systems (AGVs): Take the entire route into consideration.

↳ Document all tests comprehensibly and print out the Safety Sensor's configuration incl. protective field shapes for your documentation.

↳ Instruct the operating staff before beginning the activity. The machine company operating the machine is responsible for this instruction.

↳ Attach the instructions for daily testing on the machine so that they are clearly visible in the operating staff's native language.
You can print out the chapter "Daily function check" for this.

Checklist for testing the Safety Sensor before the machine's first startup.

Tester: Appropriately qualified person

This checklist serves as a reference for the machine manufacturer or supplier. It replaces neither the test of the entire machine or system before the first start-up nor its regular tests by an appropriately qualified person. This checklist includes minimum test requirements. Depending on the application, further tests may be required.

↳ Keep this checklist with the machine documentation.

Checkpoint	Yes	No
Have all the relevant safety directives and standards for this machine type been taken into consideration?		
Does the machine's declaration of conformity include a list of these documents?		
Does the Safety Sensor comply with the safety-related performance required by the risk assessment (PL, SIL, category)?		
Circuit diagram: Are both safety-related switching outputs (OSSDs) linked into the downstream machine control unit in accordance with the required safety category?		
Circuit diagram: Are the switching elements controlled by the Safety Sensor, e.g. contactors with positive-guided contacts monitored by a feedback circuit (EDM)?		
Does the electrical wiring agree with the circuit diagrams?		
Have the required safety measures against electric shocks been effectively implemented?		
Has the machine's maximum stopping time been re-measured and documented in the machine documentation?		
Is the required safety distance (Safety Sensor protective field to the nearest point of operation) complied with?		
Are all of the machine's points of operation only accessible through the Safety Sensor's protective field? Are all accessible safety devices, e.g. protective grids correctly mounted and secured against manipulation?		
Is an unprotected presence between the respectively activated protective field and the point of operation safely ruled out or, for example, prevented by an additional physical protective device?		

Checkpoint	Yes	No
Is the control device for activating the start/restart interlock of the Safety Sensor or the machine positioned in accordance with the respective specifications and regulations?		
Is the Safety Sensor correctly aligned (tilt angle) and are all fixing screws and plugs tight?		
Are the Safety Sensor, connecting cables, plugs, protection caps and control devices undamaged and free of any signs of manipulation?		
Has the effectiveness of the protective function of all configured protective fields and for all of the machine's operating modes been checked with a functions check?		
Is the Safety Sensor effective during the entire dangerous movement of the machine?		
Is the dangerous movement stopped when the Safety Sensor is disconnected from the supply voltage, when the machine operating mode changes or when a change is made to another protective device?		
Are the instructions for the Safety Sensor's daily test mounted clearly visible for the operating staff?		

11.2 Regular test by an appropriately qualified person

Regular tests of the safe interaction of the Safety Sensor and the machine are used to reveal machine changes or unauthorized changes, i.e. manipulations on the Safety Sensor. Test intervals are regulated by country-specific regulations. IEC TS62046 recommends a regular test every 6 months.

- Have all tests been performed by an appropriately qualified person.
- Take the country-specific regulations and the times and periods they include into account.

11.3 Daily functions test

The Safety Sensor's switch-off function must be tested daily or at shift changes and with every change of the machine operating mode in accordance with the following checklist in order to reveal any possible damage or manipulations.

WARNING

Danger of serious injury through unpredictable machine behavior with the test.

- Ensure that nobody is in the machine's danger zone.

WARNING

Machine operation may not continue if errors occur during the daily test

If you answer one of the checkpoints with *no*, the machine or the vehicle may no longer be operated.

- Have the entire machine tested by an appropriately qualified person (see chapter, "Regular test by an appropriately qualified person", page 90).

Daily functions test checklist

Tester: Authorized operating staff or commissioned person

Checkpoint	Yes	No
Is the Safety Sensor correctly aligned (tilt angle) and are all fixing screws and plugs tight?		
Are the Safety Sensor, connecting cables, plugs, protection caps and control devices undamaged and free of any signs of manipulation?		
Are all of the machine's points of operation only accessible through the Safety Sensor's protective field? Are all additional protective devices correctly mounted, e.g. protective grids?		
- Switch the machine on, wait approx. 20 s until the auto-test sequence has finished. With an automatic restart: Do LED 1 and LED 4 light green? With start interlock: Do LED 1, LED 3 and LED 5 light yellow?		
- Activate the Safety Sensor's control device (with *start/restart interlock* function) or interrupt the protective field with a test instrument* (with *start test* function). Do LED 1 and LED 4 light green?		

Checkpoint	Yes	No
Stationary applications: ↳ Interrupt the selected protective field of the Safety Sensor with the test instrument* with running operation. Do LED 1 and 4 go off? Does LED 3 light red? Does the dangerous movement stop immediately?		
Mobile applications: ↳ Interrupt the selected protective field of the Safety Sensor with the test instrument* with moving vehicle. Do LED 1 and 4 go off? Does LED 3 light red? Does the vehicle stop within the limits defined in the configuration log?		
↳ Repeat the test described above at different points of the danger zone for all configured protective fields. Do the protective field limits with stationary applications agree with the floor marking?		
MotionMonitoring: ↳ Start the test mode for MotionMonitoring on the control unit. Does alarm output 2 signal that the speed is exceeded?		

* Diameter of the test instrument in accordance with the Safety Sensor resolution of the configuration log

12 Maintenance

Clean the front screen and the scatter screens as required by the application-conditional load rating.

12.1 Clean the front screen

Use the Clean-Set consisting of special cleanser and cleaning clothes for cleaning the front screen.

The procedure for cleaning depends on the kind of dirt.

Dirt	Cleaning
Particles, loose, scouring	↳ Vacuum without touching or blow away softly, oil-free ↳ Wipe free in one swipe with cleaning cloth
Particles, loose, non-scouring	↳ Vacuum without touching or blow away softly, oil-free or Wipe free in one swipe with cleaning cloth
Particles, sticking	↳ Wet with cloth soaked in cleanser ↳ Wipe free in one swipe with cleaning cloth
Particles, statically charged	↳ Vacuum without touching ↳ Wipe free in one swipe with cleaning cloth soaked with cleanser
Particles/drops, smearing	↳ Wet with cloth soaked in cleanser ↳ Wipe free in one swipe with cleaning cloth
Water drops	↳ Wipe free in one swipe with cleaning cloth
Oil drops	↳ Wet with cloth soaked in cleanser ↳ Wipe free in one swipe with cleaning cloth
Fingerprints	↳ Wet with cloth soaked in cleanser ↳ Wipe free in one swipe with cleaning cloth
Scratches	↳ Change front screen

NOTICE

The wrong cleansers or clothes will damage the front screen

↳ Do not use any scouring cleansers or scratching cloths.

If the cleaning takes longer than four seconds, e.g. with fingerprints, the Safety Sensor displays the fault of the front screen monitoring. After the cleaning you must then reset the Safety Sensor with the start/restart button.

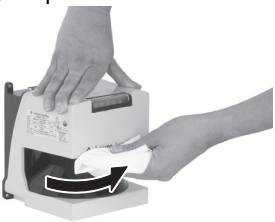
↳ Soak cloth with cleanser.

↳ Wipe front screen free in one swipe.

12.2 Clean scatter screens

↳ Soak cloth with cleanser.

↳ Wipe scatter screen free in one swipe.



13 Diagnostics and removing errors

13.1 What should I do if an error occurs?

The Safety Sensor has a three-level diagnostics concept to quickly remove errors. Proceed gradually in steps to remove an error:

- Read the Safety Sensor's status signaled by the LEDs and remove the errors with the specified measures.
- Read out the diagnostics list with the configuration and diagnostics software and remove the errors with the aid of the solution provided there.
- Create the service file with the configuration and diagnostics software and send this service file for remote diagnostics to Siemens.

13.2 LED status displays

LEDs					Status	Activity
1 Green	2 Yellow	3 Red	4 Green	5 Yellow		
0	0	1	0	0	• Boot process, configuration process • Safety-related switching outputs are switched off.	
0	2 x (1)	1	0	2 x (1)	• Boot process, configuration process • Safety-related switching outputs are switched off. • Data comparison with ConfigPlug	
0	1	1	0	–	• The active protective field is seized. • Safety-related switching outputs are switched off. • The active warning field is seized.	

LEDs					Status	Activity
1 Green	2 Yellow	3 Red	4 Green	5 Yellow		
1	–	1	0	1	• The sensor function is active; the active protective field is free. • Safety-related switching outputs are switched off. • Start/restart interlock is active.	↳ Press the start-/restart button.
1	0	0	1	0	• The sensor function is active; the active protective field is free. • The active warning field is free. • Safety-related switching outputs are switched on.	
1	1	0	1	0	• The sensor function is active; the active protective field is free. • The active warning field is seized. • Safety-related switching outputs are switched on.	Object is in the warning field. ↳ Check the warning field definition if required.

0 LED off

1 LED lights

– LED not relevant

13.3 LED warning and error displays

LEDs					Status	Activity
1 Green	2 Yellow	3 Red	4 Green	5 Yellow		
1	0	0	1	(1)	• The sensor function is active; the active protective field is free. • The active warning field is free. • Safety-related switching outputs are switched on. • Front screen is dirty.	↬ Clean the front screen as soon as possible. Device still works.
0	(1)	1	0	((1))	• Device fault • Safety-related switching outputs are switched off. • Front screen is dirty.	↬ Clean the front screen. ↬ Start the Safety Sensor again.
0	((1))	1	0	((1))	• Device fault • Safety-related switching outputs are switched off. • ConfigPlug configuration is not compatible with the Safety Sensor; the configuration cannot be transferred.	↬ Replace the Safety Sensor. The Safety Sensor type must correspond with the ConfigPlug's configuration.
(1)	0	1	0	((1))	• Device fault • Safety-related switching outputs are switched off. • Errors on the field pair control inputs	↬ Check the field pair switchover, switchover sequences and switchover times. At least one field pair must always be active. ↬ For the precise error cause, read out the diagnostics list with the software.

LEDs					Status	Activity
1 Green	2 Yellow	3 Red	4 Green	5 Yellow		
((1))	0	1	0	((1))	• Device fault • Safety-related switching outputs are switched off. • MotionMonitoring has detected a fault: Vehicle movement does not agree with the active field pair.	Check the vehicle's speed and travel direction. Check the control system's field pair switchover
0	0	1	0	((1))	• Device fault • Safety-related switching outputs are switched off.	Wait 5 seconds. The Safety Sensor performs a reboot. If the reboot is not successful, read out the diagnostics list with the software.

0 LED off

1 LED lights

(1) LED flashes with 2 Hz

((1)) LED flashes with 4 Hz

– LED not relevant

13.4 Diagnostics codes

You can create a diagnostics list with the software. The incidents that occurred during the Safety Sensor operation are listed in this diagnostics list. Each incident is given with place and number. The meaning of the incidents is shown in the following table.

Place	Number	Meaning	Activity
102	2	Data transfer error on interface X2.	↬ Check the interface parameters and start the transfer again.
103	2	Data transfer error on interface X2.	↬ Check the interface parameters and start the transfer again.
104	2	Data transfer error on interface X2.	↬ Check the interface parameters and start the transfer again.
105	6	Function, access, command not allowed with currently selected authorization level.	↬ Change the authorization level and start the transfer again.
201	4	Interface X2 time specifications not complied with, last message overwritten.	↬ Check the interface parameters and start the transfer again.
302	2	Interface X2 time specifications not complied with, send data not acknowledged.	↬ Check the interface parameters and start the transfer again.
306	5	Previous message not completely issued, interface X2 time specifications not complied with.	↬ Check the interface parameters and start the transfer again.
801	2	Error memory cannot be read, internal defect.	↬ If reset is not successful, contact customer service.
805	6	Error memory cannot be transferred, transfer error on interface X2.	↬ Check the interface parameters and start the transfer again.
1002	1	Motor does not reach the nominal speed after start, internal defect.	↬ If reset is not successful, contact customer service.
1002	2	Motor speed not constant after start, internal defect.	↬ If reset is not successful, contact customer service.
1003	1	Motor does not reach the nominal speed after start, internal defect.	↬ If reset is not successful, contact customer service.

Place	Number	Meaning	Activity
1003	2	Motor speed not constant after start, internal defect.	↬ If reset is not successful, contact customer service.
1003	3	Motor speed not constant after start, time exceeded.	↬ If reset is not successful, contact customer service.
1110	4	Safety-related switching outputs (OSSDs) cannot be switched, short-circuit with 0 V DC or +24 V DC.	↬ Check the connection/wiring of the OSSDs.
1110	5	Safety-related switching outputs (OSSDs) cannot be switched, short-circuit between OSSD1 and OSSD2.	↬ Check the connection/wiring of the OSSDs.
1110	6	Safety-related switching outputs (OSSDs) cannot be switched, short-circuit with 0 V DC or +24 V DC.	↬ Check the connection/wiring of the OSSDs.
1111	7	Short-circuit between safety-related switching outputs OSSD1 and OSSD2	↬ Check the connection/wiring of the OSSDs.
1111	8	Short-circuit of one safety-related switching output (OSSD) with 0 V DC.	↬ Check the connection/wiring of the OSSDs.
1111	9	Short-circuit of one safety-related switching output (OSSD) with +24 V DC.	↬ Check the connection/wiring of the OSSDs.
1606	4	Angle error detected, poss. rotation of the sensor housing; switch-off and reset followed.	↬ If reset is not successful, contact customer service.
1607	5	Angle error detected, poss. rotation of the sensor housing; switch-off and reset followed.	↬ If reset is not successful, contact customer service.
1608	8	Motor speed not constant during operation, poss. rotation of the sensor housing.	↬ If reset is not successful, contact customer service.

Place	Number	Meaning	Activity
1608	9	Motor speed not constant during operation, poss. rotation of the sensor housing.	↳ If reset is not successful, contact customer service.
1608	10	Motor speed not constant during operation, poss. rotation of the sensor housing.	↳ If reset is not successful, contact customer service.
1705	1	Signal of a light beam safety device of the window monitoring below the bottom limit, dirty front screen.	↳ Clean the front screen (see chapter, "Clean the front screen", page 93).
1705	2	Signal of a light beam safety device of the window monitoring below the bottom limit, oil/grease on the front screen	↳ Clean the front screen (see chapter, "Clean the front screen", page 93).
1906	1	Safety-related switching outputs (OSSDs) cannot be switched, internal or external short-circuit.	↳ Check the connection/wiring of the OSSDs. If reset is not successful, contact customer service.
1906	2	Safety-related switching outputs (OSSDs) cannot be switched, internal or external short-circuit.	↳ Check the connection/wiring of the OSSDs. If reset is not successful, contact customer service.
1906	5	Read back error on the safety-related switching outputs (OSSDs), internal or external short-circuit.	↳ Check the connection/wiring of the OSSDs. If reset is not successful, contact customer service.
1906	6	Error on the laser's switch-off path, switch-off because of eye safety, internal defect	↳ If reset is not successful, contact customer service.
1907	4	Angle error detected, poss. rotation of the sensor housing; switch-off and reset followed.	↳ If reset is not successful, contact customer service.
1907	7	Angle error detected, poss. rotation of the sensor housing; switch-off and reset followed.	↳ If reset is not successful, contact customer service.
2002	12	The configuration data displayed for the check was not acknowledged for too long.	↳ Start the transfer again.

Place	Number	Meaning	Activity
2007	18	Date of the protective field currently being transferred is older than the date saved in the Safety Sensor.	Update the PC's date and time setting.
2017	19	Data transfer error with ConfigPlug	Replace the ConfigPlug or the complete cable with plug.
2017	23	The connected Safety Sensor does not support the configuration file in the ConfigPlug.	Change the Safety Sensor, observe the device type.
2017	24	The connected Safety Sensor does not support the configuration file in the ConfigPlug.	Change the Safety Sensor, observe the device type.
2017	26	Date of the configuration currently being transferred is older than the date saved in the Safety Sensor.	Update the PC's date and time setting.
2018	42	MotionMonitoring, error with the speed matrix transfer.	Start the configuration transfer again.
2018	43	MotionMonitoring, error with the speed matrix transfer.	Start the configuration transfer again.
2018	44	MotionMonitoring, the right side of a protective field does not match the predefined vehicle width.	Check all parameters in the wizard, calculate the protective fields again and start the transfer again.
2018	45	MotionMonitoring, a protective field length does not match the predefined braking distance of the vehicle.	Check all parameters in the wizard, calculate the protective fields again and start the transfer again.
2018	46	MotionMonitoring, the left side of a protective field does not match the predefined vehicle width.	Check all parameters in the wizard, calculate the protective fields again and start the transfer again.
2018	50	MotionMonitoring, the left side of a protective field does not match the predefined vehicle width.	Check all parameters in the wizard, calculate the protective fields again and start the transfer again.

Place	Number	Meaning	Activity
2201	5	Number of measurements in the scan is too small because of motor rotation speed error or internal fuse is defect.	↳ If reset is not successful, contact customer service.
2302	1	Error occurred while scanner was starting.	Sequential error.
2401	13	Reference measurement failed, dust in the device, as the plug housing or dummy cap not screwed.	↳ Screw the plugs of interfaces X1 and X2.
2401	10	Reference measurement failed; glare from another light source (905 nm) or rotation speed error.	Safety Sensor performs reset.
2401	41	Reference measurement failed; glare from another light source (905 nm) or rotation speed error.	Safety Sensor performs reset.
2402	10	Reference measurement failed; glare from another light source (905 nm) or rotation speed error.	Safety Sensor performs reset.
2402	41/42	Reference measurement failed; glare from another light source (905 nm) or rotation speed error.	Safety Sensor performs reset.
2701	1	Invalid diagnostics command received, software not compatible with firmware.	↳ Use a newer version of the configuration and diagnostics software.
2702	3	Invalid diagnostics value requested, software not compatible with firmware.	↳ Use a newer version of the configuration and diagnostics software.
2800	2	2 field pair control inputs activated longer than 1 s.	↳ Check the switchover times of the control inputs FP - FP4.
2800	3	The protective field switchover performed does not comply with the specifications programmed in the Safety Sensor.	↳ Check the activation of the protective fields in the program wizard.
2800	4	More then 2 protective fields are activated during operation.	↳ Check the activation of the control inputs FP1 - FP4.

Place	Number	Meaning	Activity
2800	6	Unusable or defective control voltage for the protective field activation.	↳ Check the activation of the control inputs FP1 - FP4.
2800	8	No protective field activated. Can occur during operation and switching off the device.	↳ If detected during running operation, check the activation of the control inputs FP1 - FP4.
2801	1	Error while testing the inputs for the protective field switchover, internal defect.	↳ Contact the customer service.
2802	3	The protective field activation performed does not comply with the specifications programmed in the Safety Sensor.	↳ Check the activation of the protective fields in the program wizard.
2802	4	More than 2 protective fields selected when starting the Safety Sensor.	↳ Only activate one of the control inputs FP1 - FP4.
2802	6	Unusable or defective control voltage for the protective field activation.	↳ Check the activation of the control inputs FP1 - FP4.
2802	8	No protective field activated during the Safety Sensor start.	↳ Activate one of the control inputs FP1 - FP4.
2804	3	The protective field activation performed does not comply with the specifications programmed in the Safety Sensor.	↳ Check the activation of the protective fields in the program wizard.
2804	4	No protective field clearly selected.	↳ Check the activation of the control inputs FP1 - FP4.
2804	6	Unusable or defective control voltage for the protective field activation.	↳ Check the switchover times of the control inputs FP1 - FP4.
3016	11	Confirmed single password entered wrong.	↳ Repeat the password entry.
3203	6	Safety Sensor has optical glare caused by another device.	↳ Switch off the supply voltage and start the Safety Sensor again.

Place	Number	Meaning	Activity
3203	7	Safety Sensor has optical glare caused by another device.	↳ Switch off the supply voltage and start the Safety Sensor again.
3402	2	MotionMonitor, field pair activated wrong several times. Speed exceeding can no longer be corrected.	↳ Check the activation of the protective fields in the speed matrix and the speed the vehicle moved at.
3402	3	MotionMonitor, speed very much exceeded. Exceeding cannot be corrected.	↳ Check the activation of the protective fields in the speed matrix and the speed the vehicle moved at.
3402	10	MotionMonitor, maximum speed exceeded or wrong field pair activation. Cannot be corrected.	↳ Check the activation of the protective fields in the speed matrix and the speed the vehicle moved at.
3403	7	MotionMonitor, activated field pair was not released in the configuration.	↳ Check the activation of the protective fields in the speed matrix and the program wizard.
3403	12	MotionMonitor, error on the field pair control inputs. Activated protective field not defined.	↳ Check the activation of the *creep and further travel blocking* functions.
3406	8	MotionMonitor, further travel blocking cannot switch off the safety-related switching outputs (OSSDs).	↳ Check the connection/wiring of the OSSDs.

14 Disposal

Dispose of Safety Sensors that can no longer be used according to all applicable specifications and regulations.

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